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Index to Advertisers and Classified Index Following Reading Matter.

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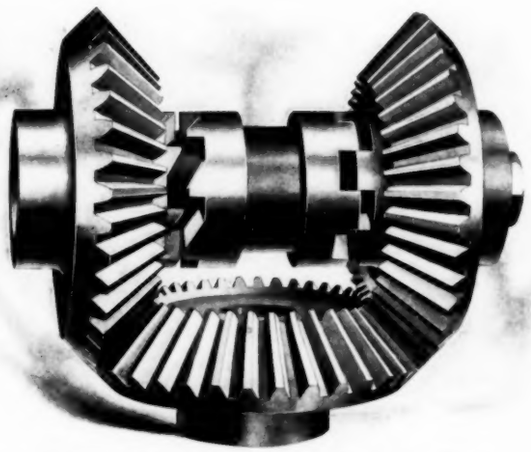

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Some Features of a Milling Machine Shop.

There is some interesting history connected with the mechanical development of the men, Messrs. Kearney and Trecker, composing the milling machine building firm of that name—history which it may be appropriate to relate at another time, while we for the present devote our attention to their shop and some of the things seen in it during a recent visit there.

Messrs. Kearney and Trecker have pursued the course so often followed by the founders of successful machinery manufacturing establishments in America. They were brought together as draftsman and superintendent, respectively, in a shop building a certain line of machine tools. Thus each had the best of opportunities for learning all about the other, and finally, with ideas of their own about a shop and what they would make in it, they concluded to launch a new business enterprise, following along in many things the lines followed by their late employer, regarding whom and whose business and mechanical methods they speak in the highest terms. At the same time they had been industriously keeping track of what others in other shops had been doing, depending mainly upon the AMERICAN MACHINIST for this, since of course their work had kept them pretty steadily at home. Their new shop was not at first, and is not now, a large one, as modern shops go, but it is made to be readily extended and the ground was at first secured for that, by going out of town sufficiently to reach reasonable land values.

Having done this the shop construction was based upon that shown in the AMERICAN MACHINIST about seven years ago in describing the shops of the De Laval Separator Company at Poughkeepsie, and there is the same splendid lighting of the interior shop spaces; the same, or at least a similar, low cost of shop building per square foot of utilizable shop floor space, and the same facility for extension in two directions without interfering with the regular shop productions.

It will be remembered that when the De Laval shops were described, the matter of adaptability to overhead cranes came up. The De Laval work calls for no cranes; that of Kearney & Trecker requires cranes, but only light ones, operated by hand. The photograph, Fig. 1, shows how such a crane is supported in the Kearney & Trecker shop. The photograph shows the evenness of the distribution of light, though it does not do justice to the amount of it, but probably the brackets which are attached to the columns will be made out without much difficulty. Upon these brackets are placed the stringers and rails for the crane runways.

The columns themselves are in this case 4-inch steel pipes, which, besides performing their functions as columns and, perchance, crane supoprts, are conductors for storm water as well, the lower end of each fitting into a casting that has a covered end extending out through the masonry foundation and connecting with the sewer.

At the left of Fig. 1 the arrangement for driving the planer and at the same time enabling it to be served by the crane is shown, and of course if it were desirable, electrically driven tools would permit the crane to travel the full length of the shop.

Fig. 2 is a view looking westward through one of the bays, and shows a strength and a distribution of light such as is probably not possible by any other means of lighting. The end windows have been mostly curtained by the photographer to avoid halation. In the foreground of this view there have been placed, at my request, two appliances for handling work and tools, that seem to me to be worthy of special attention. The first of these is a stand designed and built in the shop, composed of wrought-iron pipe with cast connecting pieces as shown, fastened by set-screws so that they are vertically adjustable, and on which are placed the planks constituting shelves. Attached to the upper one of these is a drawer for tools, and in the more recently constructed ones the lower shelf is also extended as shown in Fig. 3, this extension being for the reception of attachments such as chucks, steady-rests, etc. The second shelf extension is for the

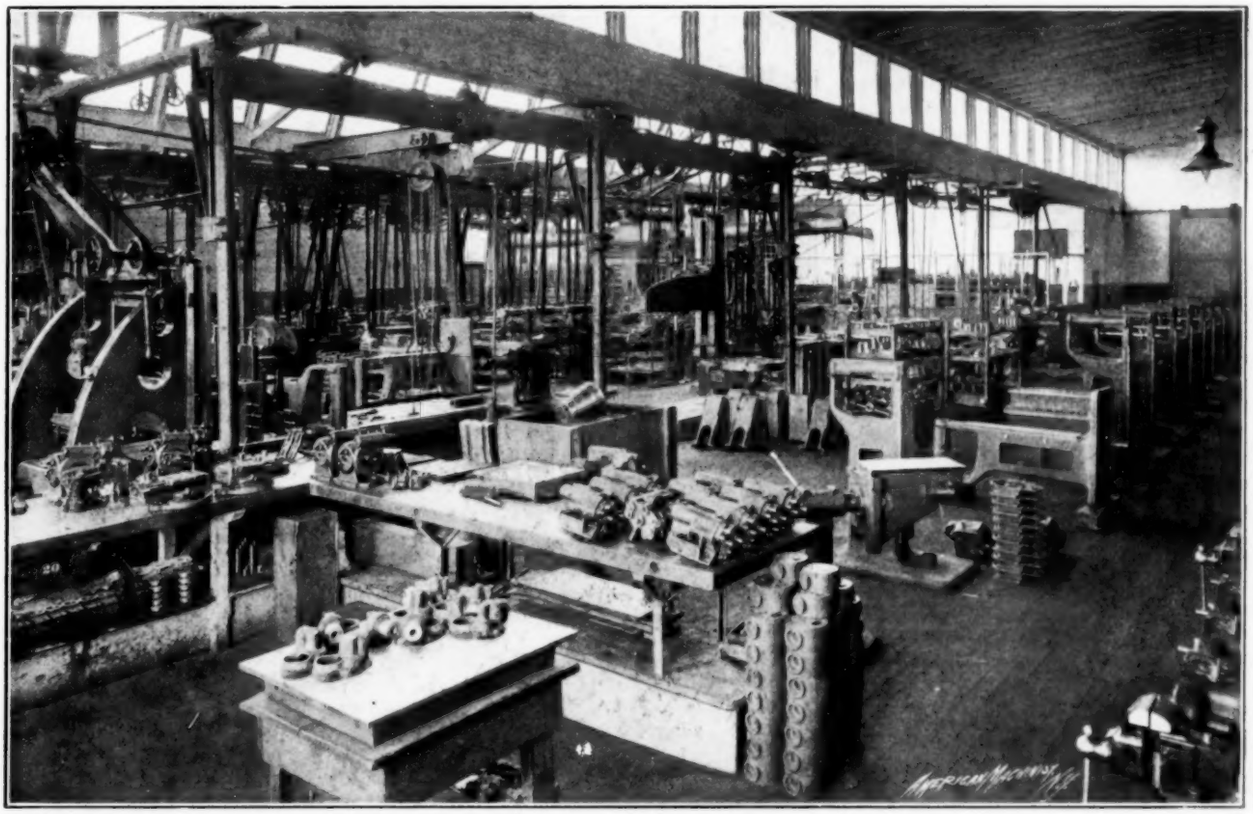


FIG. 1. VIEW IN THE KEARNEY & TRECKER SHOPS AT MILWAUKEE.

workman's tool chest. The drawer is not shown on the blueprint, because it was an afterthought. It slides on a metal track, made from ¼x1½-inch steel, which is screwed to the bottom of the drawer supports, and the under side of the drawer also has a strip of steel, ⅛x¾ inch, which prevents rapid wear and keeps the drawer in shape. One of these stands is supplied for each machine and forms a very useful adjunct to it.

The spindle truck shown back of the stand is a Towsley truck, and is well known. Its feature in this case consists in its equipment with a rack so arranged that the spindles do not have to be lifted up to the extreme top of it every time they are to be put in or taken out, but their lower ends are simply placed in position and the spindles then lean toward the center in suitable supports near the top, which is formed simply by a board, about 10 inches wide, which runs through the middle and has slots screwed to it which extend out laterally, separating the spindles and keeping them in place. Suitable blocks separate them at the bottom, and each truck holds twenty spindles, which are placed upon it as forgings and remain with that truck until by successive operations they become finished spindles. This truck idea is of course not new, but its manner of fitting out for this particular purpose is different from what I have seen elsewhere, and has, it seems to me, obvious advantages of its own.

Fig. 4, though impressive to one who understands its significance, shows nothing not familiar to one acquainted with modern tool manufacturing methods. The cost of that part of doing planer work, which consists of setting tools and of measuring or otherwise determining the depth of cuts, is distributed over eighteen machines instead of being concentrated upon one machine, besides which the fixed charges connected with the operation of the planer are very much lessened per machine.

This view incidentally shows the form of knee adopted and that it is very nearly a completely closed box. Especially is it noticeable that there is no opening down through the top for the saddle nut to pass through; the solidity of the knee thus secured is gained by placing the saddle traverse screw at one side instead of in the center. This is shown at Fig. 5, in which also it is shown, incidentally, that for this rack-cutting job at least, the screw is just where it ought to be, *i. e.*, directly under the cutter, and if most of the cutters working in this way are similarly located so that the saddle screw has nothing to do with others except to locate the work, preparatory to the operation of one of the other feeds, then not much objection can be made to it.

Fig. 6 also shows the doubling-up process on planer work: two rows of miller platens being placed and in process of having the T-slots planed in them. The tools for this job are of special interest, being so made that the tools themselves properly space the slots and similar operations are carried on simultaneously on six slots throughout.

A drawing of the tool is shown at Fig. 7, and its central idea is the making of a block with slots milled through it just the right distance apart and then making the tools with sides finished by grinding so that they accurately fit these slots and consequently, when inserted in the block, must be properly spaced. A roughing tool is first used for cutting down from the solid, as shown. Then the side cutting tools shown in Fig. 7 are inserted and these are made so that each one is both right and left hand by being reversed end for end. After that sizing tools are put in. These are not shown, but are the ordinary split tool with a taper pin for adjusting to size. The drawing is for a set of tools made for a smaller size of platen than those shown in Fig. 6, which accounts for the differences that appear; but of course they are in all essentials the same. The hook with a threaded end shown in Fig. 7 is screwed into the block and a wire rope is attached to it which runs over a pulley above and carries a weight which counterbalances the weight of the tool and holds it up during the back stroke of the planer, and, as we all know, it is rather important to do this when using the side cutting tools in planing T-slots. The pulleys that the wire ropes run over are seen over the planer at the left of Fig. 1.

By this rigging a job that, when done by the old "simon pure machine shop" methods, is a slow and tedious one, is not only done at a rate which comes somewhere near calling for the full driving power of a good planer, but at the same time the getting the slots rightly spaced and accurate generally is made much more sure.

The platen of the Milwaukee miller is specially designed for planing the slots in this way, or, in other words, so that the tools can pass entirely through a string of them and the slots are afterwards closed up at the ends by parts attached to the ends of the platen as shown in Fig. 5.

FIG. 2. A SHOP FLOOR-STAND AND A TRUCK.

The attachment shown in Fig. 5 is, by the way, worthy of some special attention as a well thought out piece of work. First, it will be noticed that it is attached by means of a piece which fits over the dovetailed surfaces on the frame of the machine and upon this piece the frame of the attachment turns to any angle, as indicated by graduations, and is secured by four bolts which engage in a circular T-slot. The outer end of the attachment is at the same time supported by the outboard bearing, and by means of the braces shown, this is again tied to the knee when desired. The arbor (and its bearings) on which the rack cutter, Fig. 5, is placed, can be removed and a suitable cover for the gears put in its place, though this is not necessary in order to use the vertical spindle for end milling because the working end of that spindle is furthest from the observer in Fig. 5, and the rack-cutting spindle does not project as far as the other spindle at that end. This vertical spindle is as large as the main spindle of the machine, is slightly more powerfully driven (not that it need be, but owing to the fact that the gears worked out that way) and is used for heavy face milling, spiral gear cutting, or any work for which a vertical spindle machine is adapted.

It may be worthy of remark in passing that Kearney & Trecker are not converts to the positive feed idea. In Fig. 6, which shows the vertical spindle attachment in position for work as such there is seen at the extreme left a feed pulley. Below is a similar one and the belt which connects them was calculated for and is believed to be of sufficient capacity to carry any cut that the machine is capable of driving. It is not changed for the different rates of feed, but these are secured by mechanism enclosed in a gear-box and which is manipulated by indexed levers from the outside, as is now the usual practice. F. J. M.

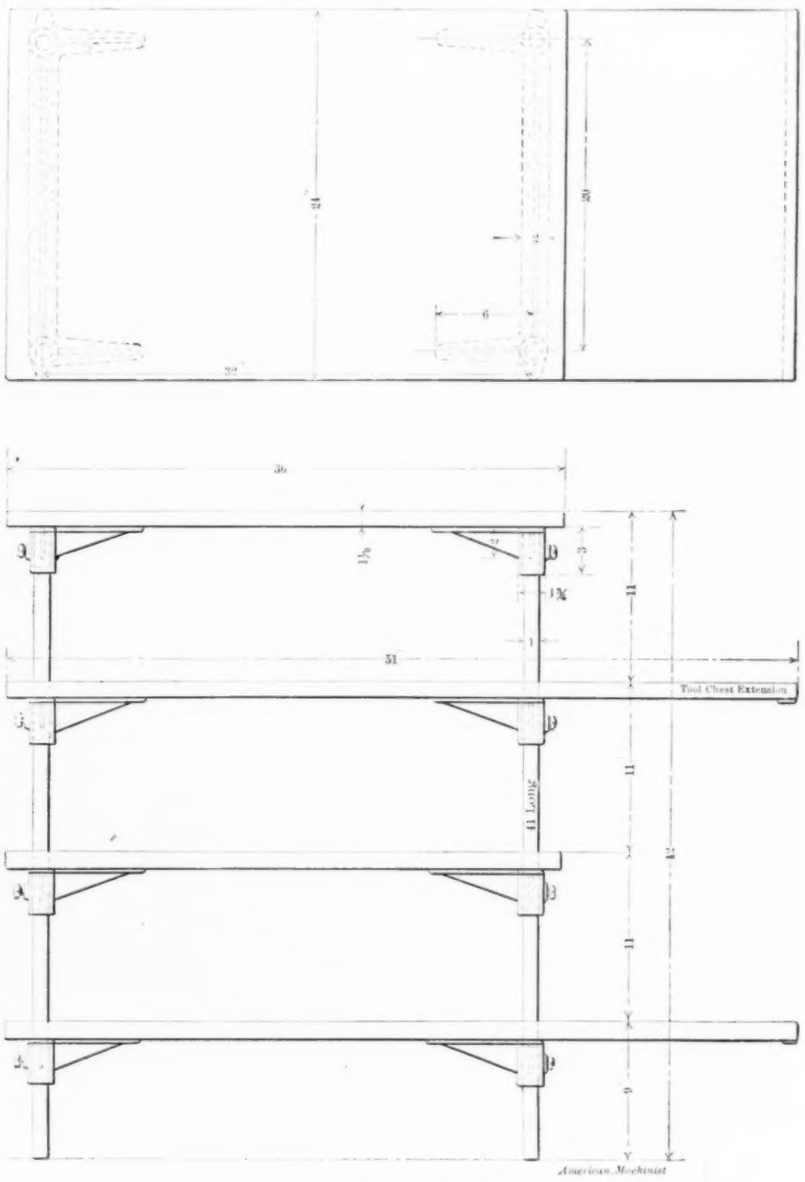


FIG. 3. WORK RACK USED BY KEARNEY & TRECKER.

Some Points About Grinding.

We announced some time ago that Mr. C. H. Norton, who for years has made a special study of grinding machines and grinding processes and has contributed to our columns articles about grinding, would undertake to answer questions about that art as practiced in machine shops.

We have received some inquiries as follow: First is a letter from an English reader, who writes as follows: "I have some vulcanite rings to grind absolutely true all over. I find it very difficult to get a first-class result. For instance, in turning them it grinds the tool away, and a diamond does not give a very good result either. So I have tried grinding them on a Landis universal machine, with different grades of carborundum and emery wheels, using water and also working them dry. But the wheels I have tried only get clogged up with the dust, and do not give a nice smooth finish as required. These rings are about 9 inches diameter, 7¾ inches bore and about 6 inches wide, and I should be pleased to get out of this difficulty, if your expert could give me a little information. Also should be pleased to get his advice as to the best kind and grade of wheels for grinding soft yellow brass."

This is replied to as follows by Mr. Norton:

"This material varies so that the writer would not venture an opinion. Some of this material would change its shape every few minutes with the slightest change in the atmosphere, while other material would remain practically still while being ground. Water will usually change its shape; oil will throw it out of shape. However, if the clogging of the wheels is the only difficulty this party has, it is a matter very easily remedied. He should simply use a wheel that is called soft. I do not know what wheels he has used, so cannot advise what wheels to use. I should think, however, that a vitrified wheel, No. 60, grade either I, J or K, might do the work; but could not say which grade would be best. The speed of this work passing the wheel, and even the speed of the wheel itself, would need to be experimented with to get results. There is no need whatever of wheels clogging with the material when it is understood that this is caused by a wheel being too hard. Simply make the wheel softer and try again."

Another English reader writes:

"At the works where I am employed we use a great many 2, 3 and 4-inch cast-iron cocks, both straight-way and three-way, and to get them steam tight we grind them in together with oil and emery. The shanks of the plugs are chucked in a bell chuck and rotate back and forth. They are not always satisfactory when

ground in this way. Sometimes they are scored, and in the case of the three-ways the two narrow ports grind off quicker than the wide port. Then they have to be dodged in by hand. I propose to have an emery wheel attachment, fastened on a rest, at the back of the lathe, and after the shell is bored out, to grind them out before taking them off the face-plate, to avoid resetting, and to grind the plugs to fit after being turned. Would they be steam tight after being ground in this way, and would an ordinary lathe be good enough for the job? Would it be required to use water on the wheels? At about what speed should the wheels run? The 3-inch plugs are 3 7-16 diameter at small end, and length of taper 6¼; taper, 3½ to the foot. The cocks are tested to 80 pounds steam pressure."

Mr. Norton replies as follows:

"In regard to the grinding of cocks both straightway and three-ways. It is common practice in this country, I believe, to grind them together as the inquirer has described. This never seemed a correct method to me. The Brown & Sharpe universal grinding machine running in our works is at this time grinding a great many sets for some manufacturers near us, and with it we grind first the taper hole with an internal grinding fixture, making this taper to a standard alike for all. We then grind the external taper or spigot to exactly fit the internal tapers. By these means there are no grooves left and the surfaces do not easily rough up and stick. I should think that a universal grinding machine would be very useful for that kind of work. I believe that is the proper way to manufacture such cocks; and, as for being steam tight, I can assure the inquirer that they would be, provided reasonable workmanship was secured. I believe that there can be no special machine designed that would be more useful than the standard universal grinding machine of today."

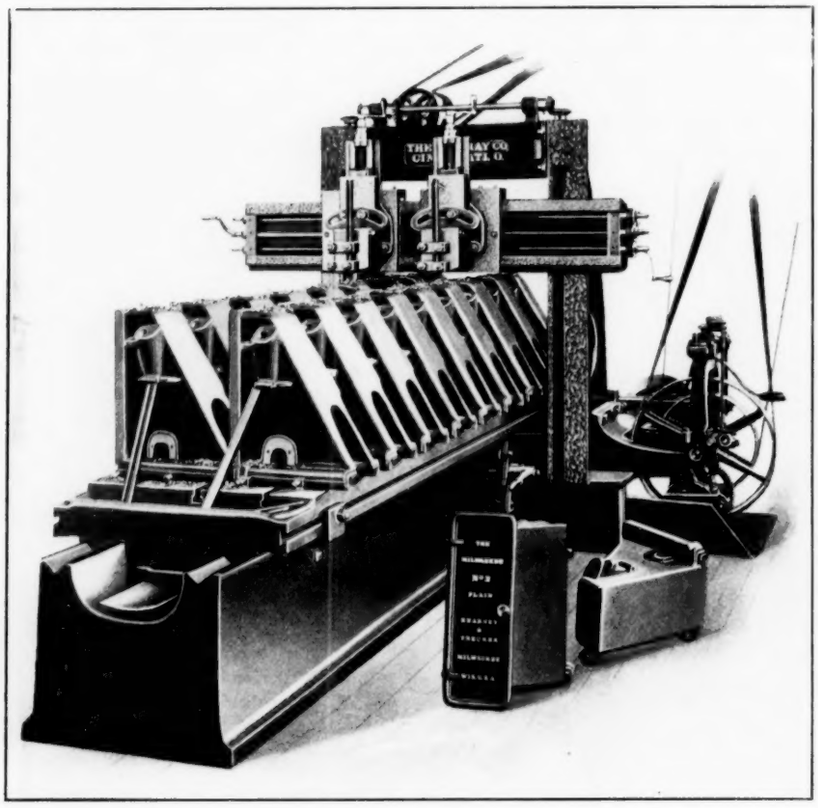


FIG. 4. PLANING KNEES.

An Illinois reader writes:

"At the shop where I am employed we have several emery wheels which we wish to group together and hood and connect to a fan so as to conduct the dust away, the wheels being run dry. I have never seen nor read any description of how it is done. I have seen cuts of it in the AMERICAN MACHINIST from time to time, but never anything that would give me insight as to how it is done. It must be simple and cheap to install. Will an ordinary blacksmith fan be sufficient, or does it require a special fan? Also how is the exhaust or dust gotten rid of? Any and all information on this matter will be very thankfully received, as I am the fellow that has to make up his mind."

Mr. Norton replies to this as follows:

"I had hoped to go into this matter somewhat at length, giving some illustrations, but find it impossible to do so within a reasonable time, although it could be done later. This matter of conveying dust away from grinding wheels is a very important one, but unfortunately is not thoroughly appreciated by a majority of manufacturers; even those who have spent money to do it in many cases do not seem to understand that the result desired has not been obtained, and that the reason for its failure has been that the idea prevailed that it could be done in a simple and cheap way. The inquirer says: 'It must be simple and cheap to install. Will an ordinary blacksmith fan be sufficient, or does it require a special one?' These are the conditions usually imposed upon the engineer when he attempts to accomplish what is sought for, and he usually fails because he lives up to the conditions. Dust

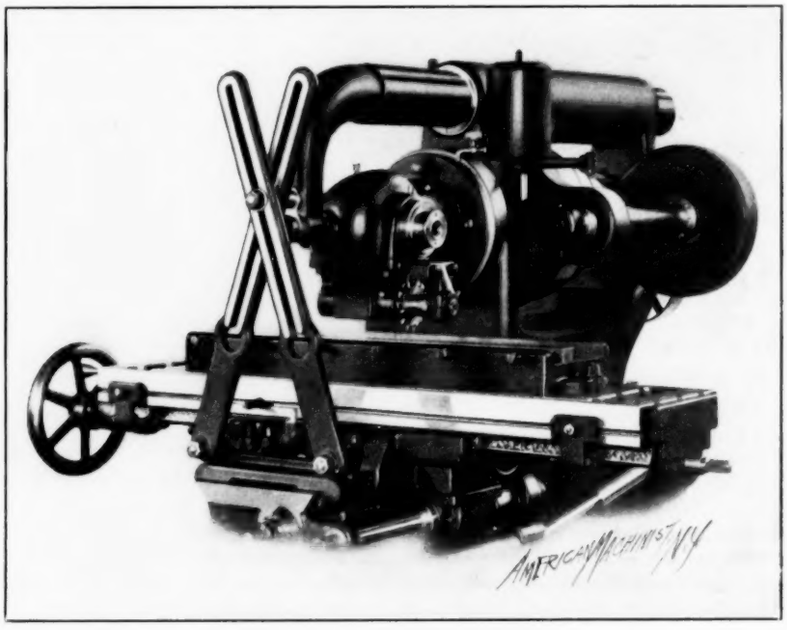


FIG. 5. ARRANGED FOR RACK CUTTING. SADDLE-SCREW AT THE SIDE.

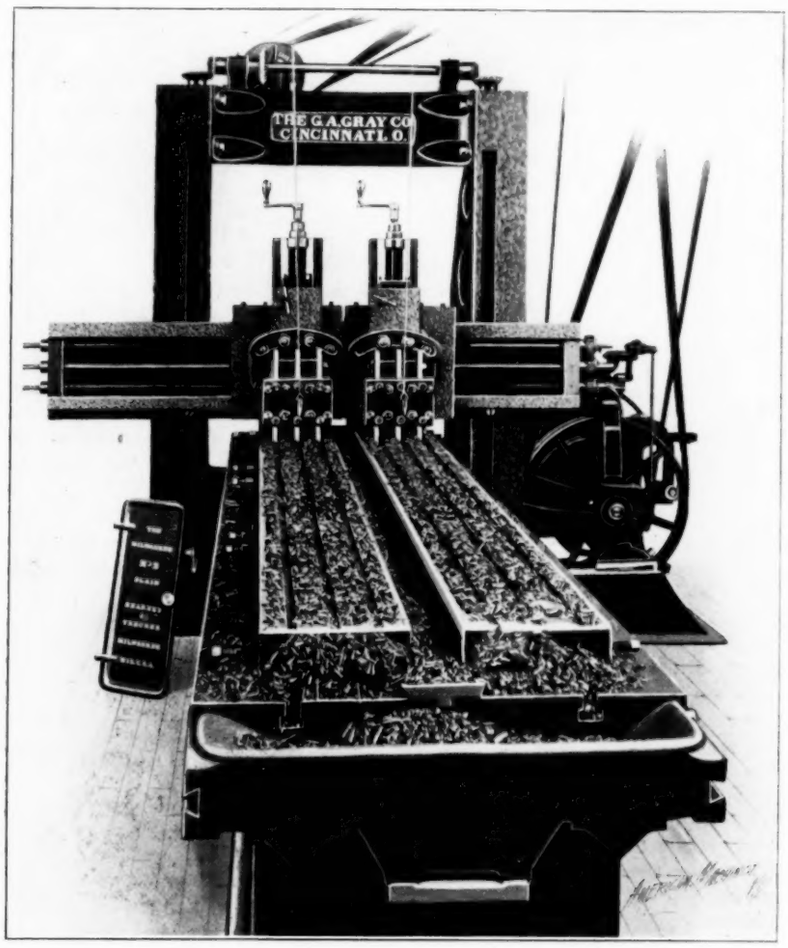


FIG. 6. PLANING T-SLOTS.

cannot be taken away from one emery wheel successfully with a blacksmith's fan, for this is usually the smallest and cheapest on the list of the blower manufacturers. While a fan with wings 30 inches in diameter will remove the dust fairly successfully from quite a number of emery wheels, it is true that a fan any smaller than that will not remove the dust from one emery wheel successfully. In this matter friction of air in the pipes must be dealt with. To overcome the friction in the best of pipes and keep the air moving fast enough for any purpose requires a fan at least 30 inches in diameter. If I were to install such a plant to suit myself, and had half a dozen emery wheels to take care of, I would put in a fan 38 inches diameter of wings and whatever the size of opening and outlet might be in this fan, should enlarge the pipe immediately after connecting with this opening and outlet to at least 24 inches; would continue this size until reaching the branches. It is then necessary to make the branches to the different emery wheels of such relative size according to the distances of each wheel from the main line of fan that there will be about the same amount of air moving through each pipe—that is, the nearer the emery wheel is to the fan, the smaller should the pipe be that conveys the air from it. The further away the emery wheel is from the fan, the larger the pipe should be connected with it. This is something that requires judgment in planning to make it work well. I would caution the inquirer never to place any dust pipe where it is impossible to get at it to clean it out, for any attempt to carry dust through pipes and have it accumulate will cause failure, for the larger the pipes the more sure the dust is to lodge in them. And, as I understand it, the desire is not to deposit the dust in any particular place so much as to prevent its entering the breathing apparatus of the operator. To insure the latter, large pipes are absolutely necessary, and large pipes are apt to be lined more or less with dust. This dust will become red hot at times so that it is dangerous for these pipes to be near any inflammable material; such pipes have caused disastrous fires. There should be large openings here and there where they can be cleaned out occasionally and they should always be in plain sight. The end

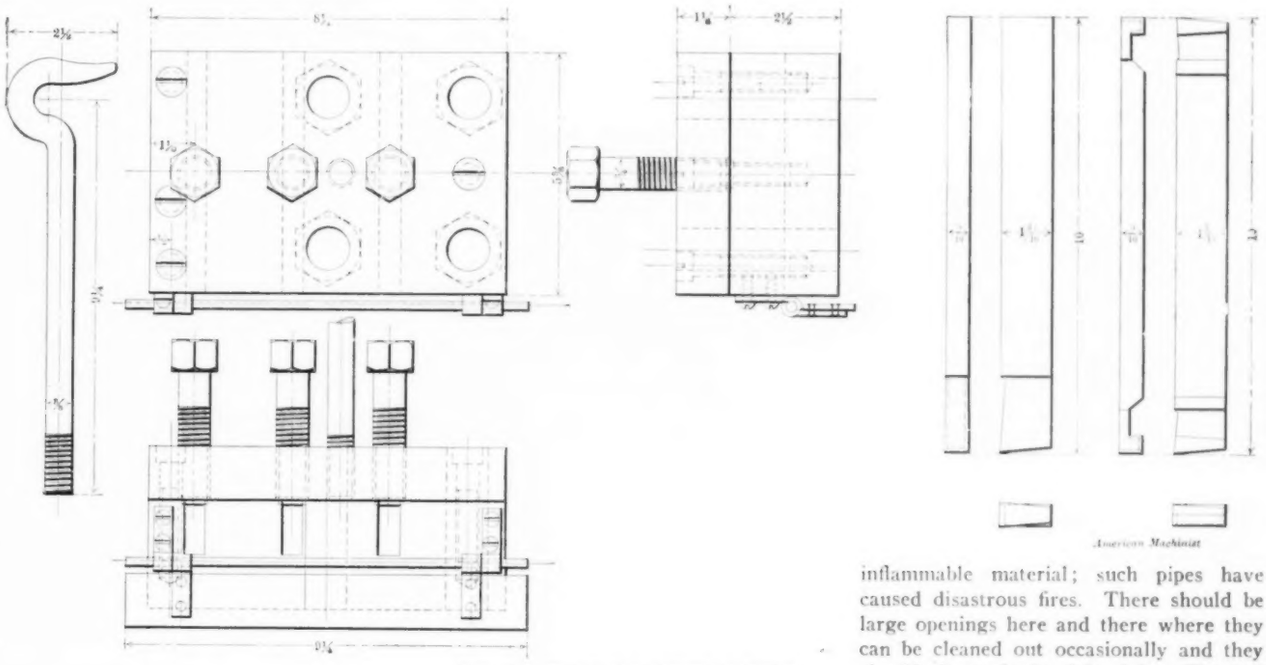


FIG. 7. TOOL FOR PLANING T-SLOTS.

of the pipe receiving the dust from the wheel should be so shaped that the dust from the grinding will go directly into the opening, for it is impractical to create a current strong enough to deflect those particles from their natural course. When they have once entered the funnel they will find their way into the wide pipe and not come into the room again. Inquirer asks how to get rid of the dust—after it is taken into the pipes, I suppose he means. Most people simply blow it outdoors, allowing it to go where it will. I think there are better ways than this, however. If a large vertical pipe is erected, or suppose we blow this into a large chimney: the larger the chimney the better. In that case the motion of the air will be so slow within the chimney that before the top is reached the dust will find its way to the bottom. Sometimes a brick manhole is made in the ground. The size of these manholes gives room for the air to become practically quiet, at least the air coming from the opening is moving very slowly. This will usually allow time for the dust to fall to the bottom of the manhole and be cleaned out occasionally. The rule I would lay down for fitting up such a plant would be to use as large a fan as the available room and the management will allow. In my opinion the fan cannot be too large. Many emery wheel plants are fitted up with exhaust fans which have been installed cheaply; in fact, that is the traditional blacksmith's fan, and this fan is roaring and groaning in a vain endeavor to keep up its reputation for removing the dust, but the dust is not removed, or at most, only a portion of it."

A Missouri reader writes:

"I should like to know what kind of wheel can be used to the best advantage for grinding Mushet steel brick molds for pressing dry brick. My experience was two days' steady grinding at one plate, wet, with 14x1-inch emery wheel, which would glaze every few minutes. Wheel was 60-grain; size of plate, 7x8 inches. Next trial was with a carborundum wheel, 10x½ inch; speed of both tests, 900 turns per minute. Carborundum wheel, 80-grain, running dry, two plates per day; running wet, the wheel would glaze in one minute to such an extent that it would do no more grinding at all. This grinding was done on Landis No. 3 universal grinder, on headstock revolving plates at a slow speed. Please let me know at what speed and what kind of wheels to use to get the best results, grinding wet."

This is replied to as follows:

"Mushet steel requires wheels that are unusually free cutting; wheels that will wear away quite soon, in order to do the work quickly and not crack the steel. It also requires a large flow of water, and this water should be mixed with soda and oil. I find more and more each day that there should be a lubricant in the water in which grinding is done. The more difficult the grinding is with Mushet steel the more call there is for the lubricant. I think that 100 parts water and about 1 per cent. oil and sufficient soda to mix the whole well and prevent rusting, is about right. The rule is to apply soda until the water feels quite strong. I do not know the exact grade of wheel to recommend to him, because I do not know the exact speed which the work may be running at. I should try the following wheels: 36, grades H, I and J; *i. e.*, three different wheels made of No. 36 pure corundum of three different grades; should then try different speeds of each wheel and different speeds of work; should start with not more than 10 feet a minute for the surface of the work; that is, in this case I conclude it is a flat block turning on the face-plate. The fastest part of this block should not run over 10 or 15 feet a minute. The wheels should make about 5,000 feet per minute, and I should use as large a wheel and as broad a face as the machine will carry. If with this speed of work the wheel glazes over, reduce the cut and increase the speed of the work until the point is reached where it is free enough cutting. If the wheel is soft enough it will cut right at some of the speeds. If it is too hard the increase of the speed of the work would cause what we call jumping. The traverse of the wheel across the work is very important. To keep the wheel free cutting it should traverse across the work an amount equal to its width at every rotation of the work, and the wider the wheel can be, of course, the more work can be done per minute. The correct way to order the wheels mentioned is as follows: Give the diameter, size of hole and thickness. This should follow: Silicate, pure corundum, No. 36, grades H, I and J; *i. e.*, three wheels. In all these cases where I recommend wheels of certain numbers and grades and material for different work, it should be understood that I do not understand anything about the relation of parts and grades and material to grinding work in any other wheel than the 'Norton' wheel, made at Worcester, Mass. That is, I have insufficient experience with other wheels to be competent to recommend understandingly."

[We presume that makers of other wheels will be able to specify grades of their make corresponding to those mentioned by Mr. Norton.—Ed.]

An Old Engine.

Up to the end of last year one of the oldest engines in the world was running in the works of Charles Clifford & Son, Birmingham. It was a beam engine started in 1767, and the original oak beam worked 135 years. A cast-iron beam was made for it by Bolton & Watt about a hundred years ago, but it was never used. The original connecting rod was never replaced, but a new cylinder was made in 1802 and rebored about eight years ago.

Die for Piercing Brass Shells.

BY C. H. ROWE.

The subject of this article is a die for punching three holes (two of which are shown) in the side of the drawn brass shell, Fig. 1; two of the holes are opposite each other and are 0.144 inch diameter, the third hole being 0.228 inch diameter; the stock is 3-32 inch thick. The side views of the punch and die, as shown in drawings, indicate clearly the plan of construction and show the device for gaging the work in order to have the holes punched between the raised sections of the piece. While this type of die is commonly used for piercing thin stock and relatively small holes, I have never before seen it used for punching stock of the above thickness, probably on account of the inadequate means, and also because of the unusual size of the springs, if these were to be used, that would be required to strip the punches clear of the work and cause the slides to

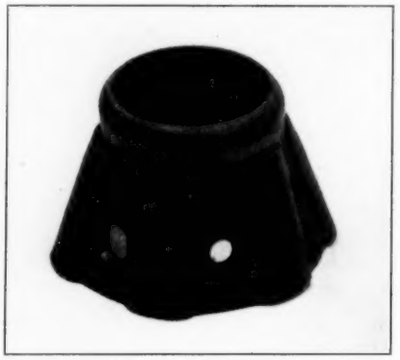


FIG. 1. THE FINISHED PIECE.

travel outward. The means provided in this case for drawing back the slides—that is, cams attached to the plunger—form a simple and positive arrangement, and one that does away with the use of stiff springs to move the slides out, thus to an appreciable extent decreasing the power required to operate the tool, and also permitting the slides to move with perfect freedom. It may be noticed that the die is so designed that there is no provision for grinding the conical surface; but, if the tool is carefully made throughout and a limited variation between the size of the piercing punches and the holes in the die allowed, instead of a close fit that is unnecessary for stock of this quality and thickness, the holes can be punched clean without any burr being left around them and the life of the die will be greatly increased. And it will not only stand up well in practical use, but will also fully cover the requirements of accuracy and uniformity within the limits which are necessary for this class of work. For convenience only one perforating punch slide is shown; the three were made independently of each other and of the same general design, and afterwards located in position on the face of the holder, two of them (for the small punches) sliding in on

an incline and the third moving horizontally.

The die-holder *A*, Fig. 2, consists of a round cast-iron plate, surfaced top and bottom, and bored at the center on the face-plate to receive the die *B*, which was turned a little large on the outside and afterwards drilled as at *C*, to allow the scrap punchings to pass through; the small hole drilled through the top allowed the steam to escape when hardening.

The indexing head of the milling machine was set in a vertical position with piece *B* held in the universal chuck and the large hole *D* in the side carefully centered, drilled and reamed to size; the head was next tipped 18 degrees and the spindle rotated 60 degrees to bring the piece in position to locate and finish hole *E*, and then turned one-half way around and hole *F* finished opposite *E*. The object of tipping the indexing head spindle was to have the axes of holes *E* and *F* correspond with the lines of travel of the two inclined slides. A little clearance was given the holes with a smooth, round file, care being taken not to touch the outside. The portion of piece *B*, situated above the holder, was hardened and ground to taper and size, and fitted snugly into the hole in *A*, and pin *G* was then driven in to prevent its turning. On the face of plate *A* are located and fastened, by two 5-16 inch screws and two ¼-inch dowel pins in each, and in correct positions relatively to the holes in die *B*, the blocks *H* for the three slides. The cast-iron body *H* is planed on the outside to the shape shown and the way or guide is machined, and capped with the flat steel piece *I* held by four flat-head screws. The piece *J* is hardened and ground to a sliding fit in *H*, to insure the proper entrance of the end of the piercing punch in the hole in *B*; its inner end has a square-seated hole that receives the punch *K*, which is secured by the ¼-inch set-screw *L* in the side. The ⅜-inch hardened pin *M*, held in place by the set-screw *N*, projects out beyond *H* on both sides, and one end engages with the 1-32x5-16 inch flat spring *O*; the object of this spring is to hold the slides that move in on an incline, out and away from *B* when removing and replacing the work. It is fastened by two round-head screws *P* to holder *A*, as shown. The slot *Q* in both sides of *H* allows the slides an end movement of ⅜ inch.

The attachment *R* used in gaging the work is shown in about the position it occupies when secured by screws and dowel-pins to *A*. The body is of cast iron and fitted with a spring plunger *S*, which at the outer end is beveled to coincide with *B* and notched as shown in the elevation to embrace one of the ribs on the outside of the shell when pressed against it by spring *T*. Pin *U* driven into *S* prevents its turning, and the slot allows it to be pushed back the required distance when slipping the work on and off.

Referring to the plunger drawing, Fig. 3, *A* is the round cast-iron holder on top of which is fastened by screws and guided by dowel-pins an elongated beveled-edge plate, ¾ inch thick (not shown), for keying the plunger to the press ram. *B* is a piece with an inclined face, made from 1-inch thick tool steel. After finishing the lower end smoothly it was made very hard to stand the wear. Besides fastening it to the holder by two ⅜-inch screws it is backed up by the ½-inch pin *C* driven into *A*. Let in the side of *B* ⅛ inch and held there tightly by two 12—24 screws is the ⅜-inch thick stripping cam *E*. An important feature of this piece is the inclined surface at *F* by means of which, in case the flat spring *O* (Fig. 2) gives out and the inclined slides move in by gravity, they will be moved out again and the end of *E* will be prevented from striking abruptly on pin *M*.

On the down stroke of the press the spring pad G, which slides up and down in sleeve H and is kept from falling out by pin *I* passing through vertical slots in the sleeve, comes in contact with the end of the inverted shell or cup on the die *B* (Fig. 2), and holds it firmly while the slides move in and pierce the holes. The sleeve is secured to *A* by four screws, two of which are shown in the drawing.

A tool of this type, to be successfully operated, should be used in a press where the ram has more than the ordinary travel usually found in the common blanking press, so as to free the operator from any incumbrances and allow of handling the work quickly. Following this piercing operation the bottom of the piece was punched out in a plain round cutting die.

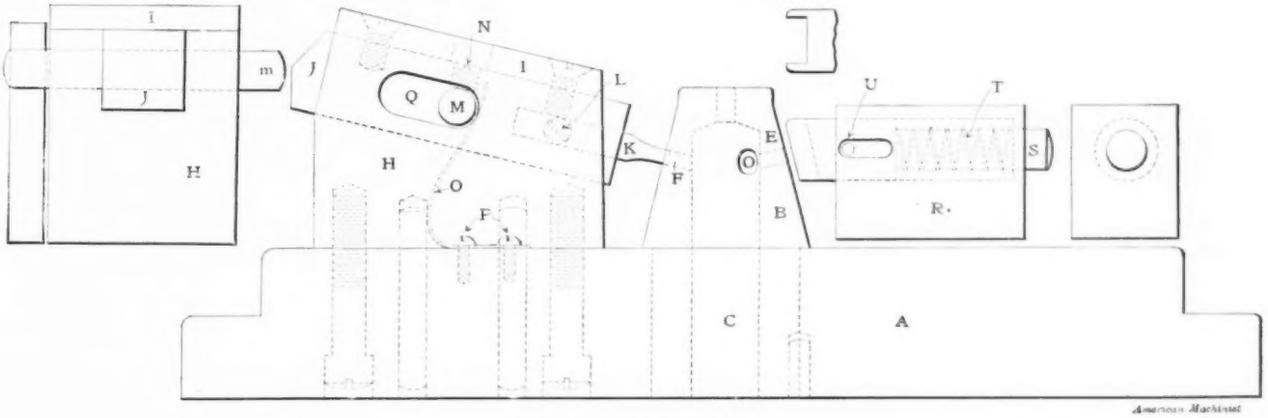


FIG. 2. PIERCING TOOLS.

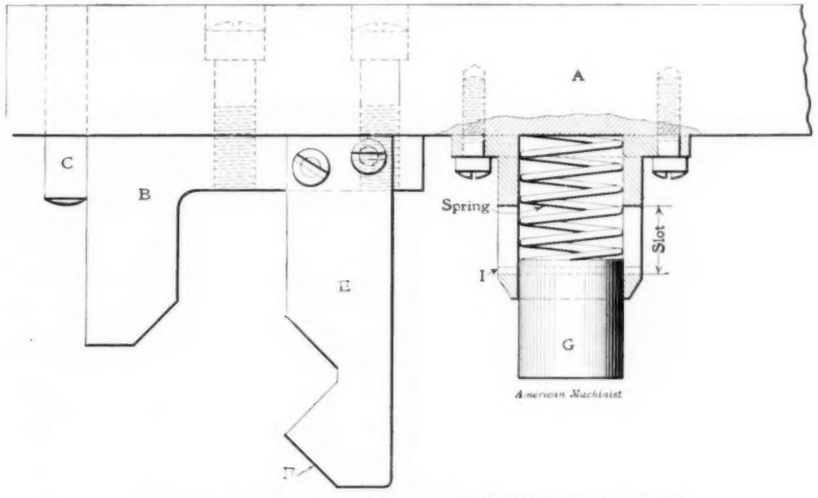


FIG. 3. HOLDER WITH DEVICE FOR MOVING PIERCING SLIDE.

Jewelry Die Work.

At page 1758, Vol. 25, Mr. Frank Greiner gives an interesting description of some methods of making dies for eye-glass "straps," which we here are more accustomed to calling "clamps." Perhaps a few words upon the same subject by another who has been engaged in the same work in a different part of the country would also prove of interest, especially if the methods herein described are not generally known, and I have reason to believe they are not as well known as they should be. As it is much easier and requires less haste in striking an impression in cold steel than in red-hot metal, this other method ought to have a few points to commend it.

In our practice the sample was worked out to shape as usual and soldered to the end of a punch blank taken from the stock. These blanks were turned 1⅛ inches diameter, about 5 inches long, with one end turned taper 2 inches long, with the small end large enough in diameter to well cover the sample. The sample is then soldered to the end of the punch blank, and the outline of the clamp is carefully worked out on the end of the punch in the bench miller. These outlines are carried only about 1-16 inch from the face when the punch is taken to the shaper and the shape is carried up the punch, but tapering; after which it is carefully filed so that the end of the punch will have the perfect outline of the sample and that article may then be removed and the face of the punch shaped as the finished article is to appear.

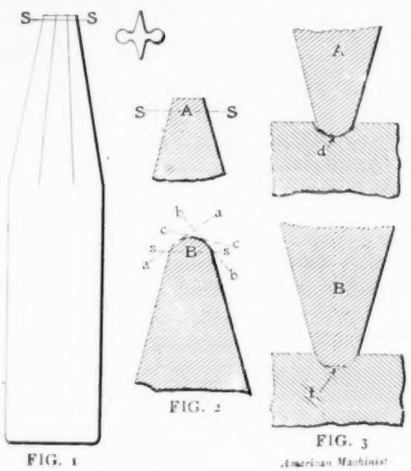
This shaping requires a little exercise of the artist's talent, but it is not so very difficult if gone at with a little system. The systematic method would be to coat the end of the punch with the copper solution, and scribe a line completely around the punch a distance from the end face equal to the thickness of the finished clamp like *S S* in Fig. 1, which line is carried completely around the end of the punch.

Referring now to the other sketches, the sectioned portion *A*, Fig. 2, represents a section of a punch which it is necessary to round off, as in *B* in the same figure; the dotted line *S S* represents from the end of the punch the thickness of our sample and therefore where the rounding should end.

Suppose we are to round the end of our punch to the radius shown; we can begin by beveling or chamfering with a file held at a constant angle, like *a a*, and carry this chamfer all around the punch, preserving the angle and width of the chamfer. By keeping this angle and width the same all around, we gage the amount of metal taken off. This done, change the angle of the chamfer, as *b b*, going all around again and observing the same precautions as to angle and width. Now change the angle of chamfer again, as *c c*, and proceed as before. By this method we can remove the same amount of metal all around, or at opposite points, as the case may be, with the assurance that we have taken it off equally, since we have had a little something to gage our work by, which would not be so easily done if the attempt was made to finish first one-half to a given radius, and then the other.

We can now proceed to file to a finish by continuing to take off the "corners" which the flats *a a*, *b b*, *c c* have left, and so on, depending on the size, etc., of the work, and finally arrive at the finish which is continuously rounding. Of course, different portions of the work are sometimes finished to different radii, but the same rule can be followed where two or more opposite or similar points are to be finished. File all similar parts to the same angle and width of chamfer, to insure the same amount of metal being removed, and, where necessary, change the angle of *a a*, *b b*, *c c*, etc., to give a convexity of greater or lesser radius.

This may seem to some like elementary matter, but I believe that, making this principle known, many will be put on their guard and there will be fewer lop-sided



JEWELRY DIE WORK.

punches such as usually are produced when the attempt is made to originate a form of this kind by finishing the curve first on one side and then on the other. Practice will, in this case as in all others, lend skill to the hand and eye. We now finish the punch by polishing very highly, hardening and drawing to pale yellow, and burnishing.

Our dies were made of round annealed stock, turned to 1½ inches diameter, the ends faced to about ⅞ inch thick, and the face into which the impression was to be struck finished to a very high polish. Not the slightest scratch is permissible upon the face of either punch or die. This being done, we can take our punch—which we will now call our "master" punch—and the die blank, to either a screw press or drop press, set both in their respective places, and, when all is in readiness, carefully clean both and oil very slightly with oily fingers. All being firmly fixed in position, the impression is now made. If a screw press is used, a few strong blows will be necessary, and if a drop press—which I prefer—estimate about the proper hight from which to drop the weight with the surface to annealed pieces which will soon teach one about how much is necessary to strike a given depth. Raise the weight and let fall, catching the weight before a second blow can be struck. The result of this will be a clean-cut impression with the original polish of surface almost perfectly preserved but carried down into the blank. Of course the metal will be thrown up around the impression, and this can be faced off in either a lathe or a shaper, since it is necessary to strike a little deeper than required because of the edges being rounded. The die is now marked, etc., and hardened, using something to insure it coming out of this process clean, and then the impression is polished out. It is very necessary for work of this kind (in this instance spectacle parts) that the dies, etc., be highly polished, and especially so when working gold-filled stock, for the smoother the work comes from these dies, the less buffing will be necessary to bring it to a finish.

For the high finish, either Vienna lime or fulminate of iron will give excellent results. Chuck a round stick—orange wood—in a speed lathe or drill press. Shape the end with a file while running, and use either of these preparations with water. The Vienna lime is cleaner, but I think fulminate of iron gives the most satisfactory results. We now have a die ready for business, and when this becomes worn large from use, which it surely will do in time, another die can be struck from our master punch.

After a punch has been found to give the results sought for, it is a very good plan to strike off several dies at one time, especially if manufacturing anything like this in large quantities, as there is a gritty surface to annealed pieces whch will soon wear out a die, and the form of the piece being changed will, in a greater or lesser degree, affect subsequent operations. It is a good plan also to strike off one die deeper than is in regular use, finish, and reserve as a master die. This would then make it possible to reproduce the punch also if by accident or otherwise it became damaged or lost.

To produce a punch from the master die we must, of course, use an annealed blank turned up as before and shaped to the impression in the die. This can well be done by laying out the outlines on the end of the punch blank, shape it accordingly in the bench miller, and file it to about the desired shape. Place the master die and punch in a screw or drop press—screw press preferred for this work—and drive the punch blank into the die, though not hard. Now remove the punch and ease off all spots showing contact. Replace punch blank and repeat until nearly the exact form has been taken, then ease off the sides slightly, polish highly, and return to the press for a fin-

ishing blow. The object of this is to work the punch nearly to shape, and to fit the die so that in the finishing blow the first contact will be in the bottom of the impression, as shown in *A*, Fig. 3, which represents a section through punch and die. The metal seems to flow into the die better when contact is at *d* first, and should

plained. Polish, harden and finish as usual.

Quite contrary to what might be expected by many, sinking small dies in this manner does not induce strains sufficient to be of any serious consequence, and I dare say that with annealed steel there is no more chance of loss than by the method

A Large Bement-Miles Lathe in England.

We illustrate herewith a 125-inch crankshaft lathe recently furnished to the British Westinghouse Electrical & Manufacturing Company, of Manchester, England, by the Niles-Bement-Pond Company, of New York city, the lathe being built at the Bement-Miles plant at Philadelphia.

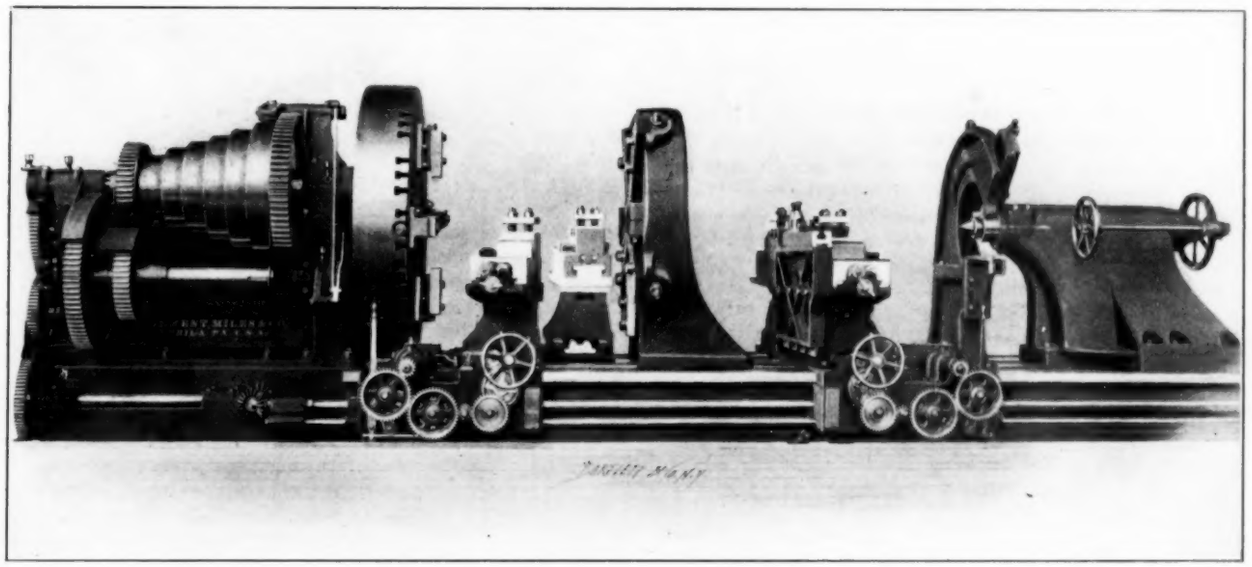


FIG. 1. 125-INCH CRANKSHAFT LATHE.

there be a scratch or other sharp indentation, it cannot be rounded out. It is also interesting to note that if a drop of oil gets pocketed in the bottom, as at *f*, *B*, Fig. 3, this oil will prevent the die being filled out, no matter what pressure is exerted, so that the rule seems to be for either the punch or the die: "Let there be no scratches or dents in either surface:

of first heating before striking the impression. In fact, an experienced man almost never loses a die.

When not in use the master punch and master die should be coated with vaseline and stored away in a vault or other safe place. If preferred, these tools can be packed in powdered lime, same as polished spring wire is packed, to preserve the

A good idea of the size and weight of this machine is given in Fig. 2, which shows it as it appeared when loaded on the Manchester Ship Canal Company's train of twenty-five cars, every one of which was required in the transportation of the lathe. The footstock, for instance, making a load for one car.

This lathe has a bed 64 feet long and

FIG. 2. TRAIN OF 25 ENGLISH CARS REQUIRED FOR CARRYING LATHE.

polish highly; keep the surfaces clean from grit, etc., and oiled, but slightly, with slightly oiled fingers, and rubbed on at that." Finish the taper part of the punch in the shaper and vise, as already ex-

polish. If either becomes dull in finish through use or age, it is always well to brighten with the fulminate of iron before using, as results are more pleasing from bright than from dull surfaces. T.O.F.

takes between centers 45 feet. It swings over the carriages (of which there are three) 108 inches. Each carriage is in all its movements entirely independent of the others and each is fitted with double, com-

pound tool slides. The feed rods and gearing for two of the carriages are clearly shown at the front of the lathe. The spindle is provided, as shown, with a six-step driving cone of large diameter and is powerfully geared; and the countershaft, which has two sets of tight and loose pulleys 48 inches in diameter, is driven by 8-inch belts. The footstock is made the full width of the bed and is traversed by power. The lathe weighs about 287,000 pounds.

Cutter and Reamer Grinder Attachment for Giving Defined Angles of Clearance.

BY CHAS. B. CHASE.

The accompanying illustrations show this attachment as applied to the universal cutter and reamer grinder of the Cincinnati Milling Machine Company.

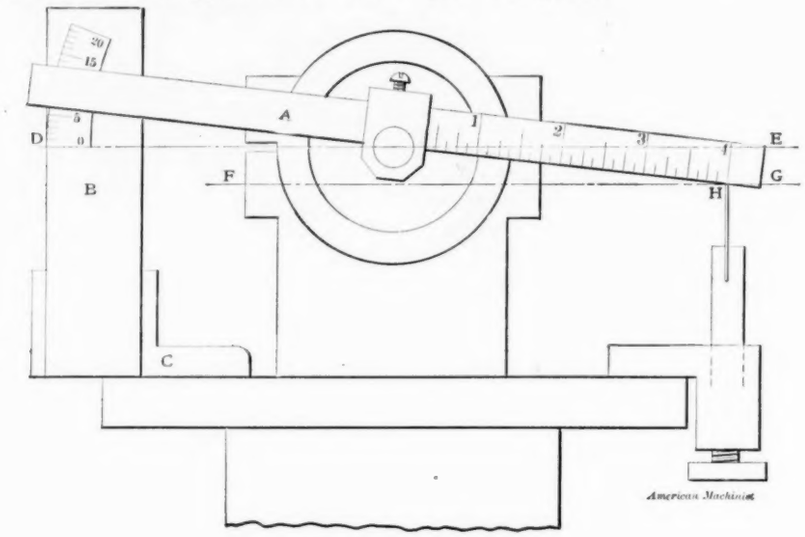


FIG. 1. ADJUSTMENT OF THE TOOTH REST.

To determine the position of the tooth rest to give any desired angle of clearance when a disk wheel is to be used, proceed as in Fig. 1. The beam *A* is set at the angle required for clearance and the top of the tooth rest is adjusted to the under side of the beam at a point whose distance from the axis of the spindle is the radius of the disk wheel which is to be used. The angle of clearance is measured on the graduated arc on the post *B* and the radius of the disk wheel is measured by rule marks on the arm of the beam.

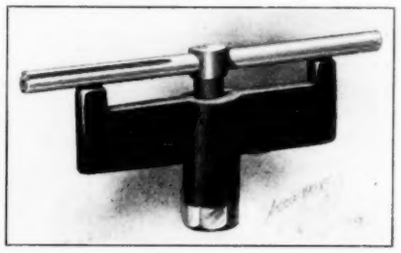
This adjustment having been made, the attachment is removed and the table of the grinder is adjusted so that the centers will be at the same hight as the tooth rest, when the disk wheel is put on the spindle and the cutter is placed between centers in the relations for grinding.

The adjustments for grinding with the cup wheel are similar, but the angle of clearance is measured below the centers—that is, below the line *F G*, Fig. 1, and the distance from the top of the tooth rest to the axis of the centers is the radius of the piece to be ground.

The advantages claimed for this attachment are: 1. It is simple, convenient and reliable. 2. In its use exact measurements are substituted for the usual guessing. 3. Its use promotes improvement in shop practice in grinding clearance angles by making it possible to record and to permanently adopt what is found to be best by reliable experiments. 4. In its use the shop practice need not be disturbed by an inexperienced man at the grinder.

Straightening Hardened Steel Articles.

T. R. Almond, of Brooklyn, N. Y., in his manufacturing operations, has had occasion to give a good deal of study to methods of straightening pieces of steel that have been sprung in the process of hardening. Among these pieces are reamers, which are used in the manufacture of his angular couplings, and we show one of these reamers within a fixture which he has devised for the purpose of straightening them. The fixture consists simply of a casting which he makes in various sizes adapted to the reamers used in his manufacturing operations and within which the reamer rests upon points near its extremities, while at the middle it is drawn down by the nut below to give it any desired amount of set. This is done while the reamer is hot, Mr. Almond's practice being to heat the reamer until water dropped upon it will hiss, or, in other words, when its temperature is probably at or a little above 212 degrees Fahr. He finds that a reamer, when at this temperature, will readily take permanent set, and he has satisfied himself by many experiments that it will, strange to say, set when raised to this temperature more readily than it will when the temperature has been raised to a higher point, or sufficient to produce a light straw color. In other words, it seems to be the fact that the nearer an approach is made to the "spring temper" the more difficult it is to produce a permanent set in a steel piece by this method, and Mr. Almond states that he is satisfied that a piece of steel can readily be straightened when heated to a temperature considerably below that of boiling



FOR STRAIGHTENING HARDENED REAMERS.

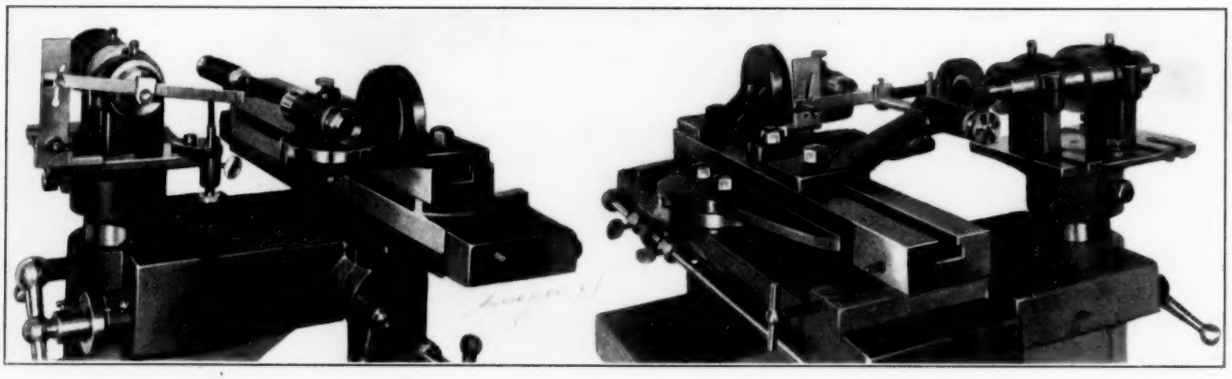


FIG. 2. USE OF THE ATTACHMENT FOR GRINDING WITH A DISK WHEEL.

FIG. 3. USE OF THE ATTACHMENT FOR GRINDING WITH A CUP WHEEL.

water, though he uses that temperature as a matter of convenience and because it answers the purpose.

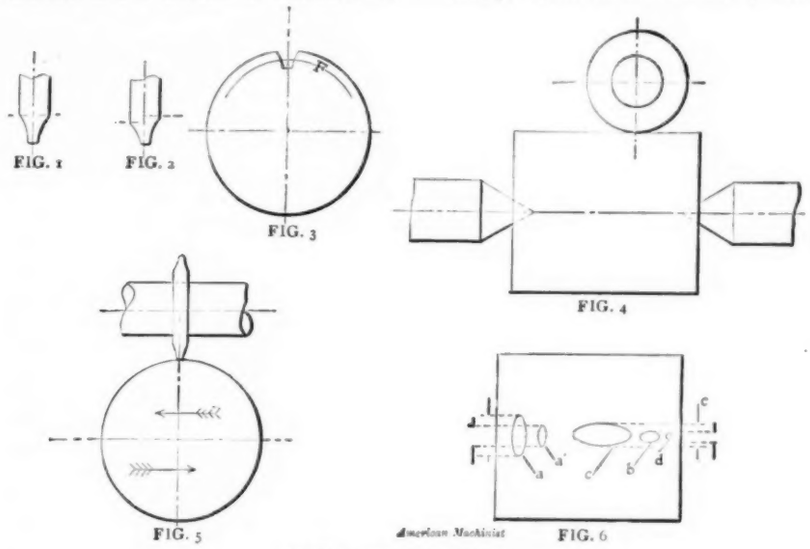
Setting Cutters Central.

BY A. B. CHRISTMAN.

When the assembling department "kicked" about the "rolling qualities" of our bevel gears, I suspected that the trouble was due to our method of "hand rolling," or the method of holding a gear in each hand and rolling one upon the other while teeth are in mesh to observe the action of teeth upon each other, which is usually considered a good enough test.

For demonstration we provided a jig having two shafts at the proper angle to each other, so arranged that a gear could be revolved on each and both enmeshing, which proved that the teeth were off center. The next step was to investigate the settings of the cutters central with blanks on the milling machines.

Finding that repeated careful settings showed no improvement, the cutters were examined and a number of variations of shape and locations of curves in relation to each other were found. For instance, the curve of one side of one cutter was of a greater radius or length than that of opposite side; in another, one curve was not in a position directly opposite its mate, as shown, exaggerated, in Figs. 1 and 2.



SETTING CUTTERS CENTRAL.

Fig. 3 shows the end of a gear blank having one space cut and a line drawn vertically through center of space. If each half of space cannot be made an exact counterpart, either by reason of defective setting (and I am not trying to place all the blame on the cutters), or imperfections of cutters, a compromise must be effected. The compromise should affect least those portions of the curves adjacent to the pitch line. The method here described will produce the compromise:

The cutter is first set approximately central and the blanks are mounted in the usual manner and the table raised as in Fig. 4. The cross-slide is moved back and forth while the cutter is running, and the table gradually raised until the cutter touches the blank in passing, as in Fig. 5, and produces a spot somewhat like *a* or *a'*, Fig. 6. Then the table is raised higher, still gradually, while the cross-slide is being adjusted so that the edges of grooves *b* or *d*, being cut, coincide laterally with *a* or *a'*. If the table is raised high enough to make *c* equal to the width of space at the pitch line while cross-slide is being adjusted, the points of curve adjacent to the pitch line, Fig. 3, will be exactly central. The shapes of *a a'* will of course vary as the relative relations of diameters of cutters and blanks and the depth of spots, but the spots are always central on either straight or taper work.

Another advantage of this method is that all setting marks are in one line and in a position that insures their removal when a space is being cut. This method was found to be much quicker and safer than the old way and could be taught to anyone, as correct eyesight was not especially necessary. Afterwards we found it useful when setting for other operations, as milling keyways, slots, and in fact for practically all operations where a space to be cut was to bear some fixed relation to the center of the work.

Size of Electric Motors to Drive Planers.

In a recently issued pamphlet by the G. A. Gray Company, entitled "Electric Motor Drive as Applied to Planers," the following figures are given for the capacities of motors recommended by them for the different sizes of planers and these figures will, we think, be very useful for general reference, though of course there are special cases in which they would not apply. The figures are as follows:

Size of Planer (Spur-geared):	22″	24″	26″	28″	30″	32″	36″	Standard.
Horse Power recommended:	2½	3½	3½	4	5	6	6	
Size of Planer (Spur-geared):	36″	Ex.	Hvy.	42″	48″	56″	72″	Frog and Switch.
Horse Power recommended:	8			12	15	15	25	20
Size of Planer (Spiral-geared):	30″	38″	48″	60″	72″			
Horse Power recommended:	6	8	15	20	25			

Electric Drive Economy.*

Mr. George W. West—I would like to ask the electrical engineers a question. I know of a great many instances where 100 horse-power of motors is required to drive tools in a shop that were formerly driven by other motors of 15 or 20 horse-power, and I would like to ask how the economy is produced in using electric motors?

Mr. Kern Dodge—I think that I can answer, possibly not satisfactorily, but I can give some kind of an answer. The motor is not put in a machine shop primarily to save power, as a great many people imagine it is, but it is put there for the other conveniences which the motor affords. It enables us to get variable speed, which is most important. It enables us to get variable speed very much more easily than it can be gotten by any mechanical means, and the men will change their speed more and bring their work up nearer the maximum cutting speed of the tool, if it is easier to do, than they will if they have a longer and heavier belt to shift, and the fact that it takes 100 horse-power motors and when you get them all running and you find they are taking only 25 horse-power, is because not all of your tools are in operation at the same time, and not more than half of them are operating at their maximum load; that is, some are taking light cuts, some are used simply for polishing, and a few of them are loaded up to their limit. If all the tools were running to their maximum, taking their full cuts, I think you would find 100 horse-power would have to be developed in the engine-room.

Mr. West—Does not the fact remain, however, that there is a greater interest charge on the money invested in the 100 horse-power motors in use than there is on the 10 or 15 horse-power motor of the other kind?

Mr. Dodge—That is very true. But you must take into consideration that you are getting, maybe, 25 per cent. more work, and your labor bill is the biggest thing you have in any machine shop. Your power equipment may amount to 3 per cent., and interest and depreciation on your motors may amount to 10 or 15 per cent. At the end of the day you have saved in labor 25 to 30 per cent., which is actually the case. I know of one shop of which I have actual data extending over two years before motors were installed and two years since they were installed, in which the cost per pound of machine, the material as it came in the shop, was reduced 20 per cent. from the time it is brought into the shop in the form of a rough casting, until it is taken out a finished product. That

* Discussion at New York Railroad Club.

means a saving in labor that is quite considerable.

Mr. West—That depends entirely on the class of work which is being done. There is a great deal of work performed in a machine shop for which a constant speed is used. If the work is straight work, nothing could be saved by using an electrically driven machine for it. I can understand that for facing down a piece of work from, say, 2 feet in diameter to 6 inches in diameter, a variable speed might be used and some time might be saved, but I do not see how time can be saved on a straight cut.

Mr. Dodge—I think that you are taking a special case. It certainly would not pay to put a motor in a shop in which you have got 100 lathes and each lathe doing one piece of work which it does from the beginning of the year to the end and always working at the same diameter; where you never do vary speed, it would not pay to put in motors. But I think if you will take the average machine shop, and the man puts a piece of shafting in his lathe which is 2 inches in diameter, and has the belt on one step of the cone and then he puts in a piece maybe two hours afterwards, maybe fifteen minutes afterwards, which may be 5 or 6 inches in diameter, I think that 10 per cent. of the time he does not change the belt. An interesting experiment was tried about a year ago in a 7-foot boring mill doing a general class of work. The machine had been running along and the man who was running the machine was very happy—no trouble at all. One day we got after that machine and decided that we would run that machine to its best advantage with the stepped cones. The increments between some of the steps were 45 per cent., and on one pair of steps it was 65 per cent., so we could not regulate it very close. We made that man shift his belt that whole day every time he should shift it in order to get the maximum efficiency out of the belted rigging, but I would like to wager that that man could not do it three days in succession; he was tired out in one.

Prof. H. Wade Hibbard—At one of the conventions at Saratoga last June I found that I stirred up a veritable hornet's nest when I made the statements that not all our railroad shops are getting the full capacity out of their tools. I was called a back number and all sorts of things because I made that statement, although there were some who corroborated it. After the session was over the president of the association met me in the corridor and he said: "Mr. Hibbard, what you said was true, and I had in mind to get up and say what you said was true from my own observation and experience." What is the use of electrically driven tools and new tool steels and the heavy lathes, the rigid lathes, if we do not run them to their capacity? I have recently visited a contract shop where I saw a planer hand, and the statement was made that on a certain class of work that he was doing with the new tool steels he was earning from $7.00 to $10.00 a day, and I would like to ask any of the railroad mechanical officers here whether they dare pay any of their machinists $7.00 or $10.00 a day? I made the statement on the floor of the convention last June that one of the shops, one of our best railroad shops, had some of their tools, which were very costly tools, which were running perhaps one-fourth of their capacity. I got that information, not from an official of the company, because apparently there was no official of the company that knew anything about it. I got it from a friend of the machinist who runs the tool, that he was running it to about one-fourth of its possible capacity. A few days later I met a gentleman upon a railroad train who said to me that he heard what I said there at the convention in June, and he said that while it might be true with some shops, it was not true of his shop. I wanted very much to say to that gentleman, "Yours was the very shop I referred to in that particular case," but I did not say it. (Laughter.) You must not only have the electrically driven tool and the modern tool steel, but you must run it and get the capacity out of it. Some of the shops are doing it, some of the shops are not doing it; the tools alone and the way they are driven are not sufficient. You have got to consider the men, and I would like to ask again if there are any of the railroad men present here tonight that have piece-work or premium plan that dare pay their men $7.00 a day; an ordinary machinist $7.00 a day or $10.00 a day? If he is really earning it, wouldn't you cut him and wouldn't that spoil it, and do not the men know that would spoil it? And so they do not work to that capacity. Is that true? (Applause.)

The Metric System in the Shop.

Joseph B. Edwards was a shopmate and for many years has been a friend of the editor of this paper. For some years he was a toolmaker in the shops of the Western Electric Company at Chicago, going from there to Antwerp, where he organized and for nearly six years was the superintendent and manager of the Antwerp shops of the Western Electric Company, manufacturing telephones for use in Europe. He introduced there a complete plant of American tools and machinery (including engines and elevators) and had a model factory. Finally becoming tired of Belgium, he concluded to return to America. Was again for some years in the Chicago shops of the Western Electric Company, but is now superintendent of the Kellogg Switchboard & Supply Company, of Chicago, the company which is manufacturing a large share of the apparatus for the independent telephone companies that are now operating throughout the country. During the time when Mr. Edwards was in Belgium he of course was using the metric system. He had previously been trained in the English system and is now back again to that system. Naturally, practical men will attach considerable importance to his testimony as to the relative merits of the two systems for the machine shop and factory purposes. He writes upon that subject as follows:

"Of the superior flexibility and convenience of the metric system in factories of our class I have been, by my experience, thoroughly convinced. The metric system is simple, rapid and accurate—a time-saver and altogether head and shoulders above the English system as a shop tool." If what Mr. Edwards says is true, it can mean only one thing—*i. e.*, that the metric system conduces to economy of production, and we can imagine no reason why he should be prejudiced in favor of the metric system. He by no means became infatuated with other features of life in Belgium or in his experience there.

Brass Lullabies for Babies.

Further cause for indignation among the cult that is for getting back to nature and old-fashioned ideas as fast as possible will be supplied by the newly invented machine of a Swiss mechanic. It is an automatic nurse for babies, and is attached to the cradle. If the baby cries, the air waves cause specially arranged wires to operate a phonograph, which croons a lullaby, while clockwork released simultaneously causes the cradle to rock. How the heart will be stirred at the sight of the motherly brass phonograph bending over the grieving pink and white mite in the cradle, "crooning" a lullaby. Did you ever head a phonograph croon? It croons in a sad, low tone like an X-ray machine and a tom cat singing a duet. It ought to cultivate a taste for music in the infant mind that might materially affect the voice quality.—*St. Louis Globe-Democrat.*

Unique Record of a Presiding Officer.

At the recent annual meeting of the Institution of Mechanical Engineers (British) the president, Mr. W. H. Maw, retired after two years' service, being succeeded by Mr. J. Hartley Wicksteed. A unanimous vote of thanks was given the retiring president, the mover and seconder bestowing the highest praise upon the retiring officer and noting his unique record. He had never missed a meeting, had never missed a meeting of the council, had never missed a meeting of committee, and had never been late. The membership of the Institution now numbers nearly 4,000, the gain during Mr. Maw's incumbency being more than 11 per cent., while the graduate class increased at the rate of 40 per cent. per annum.

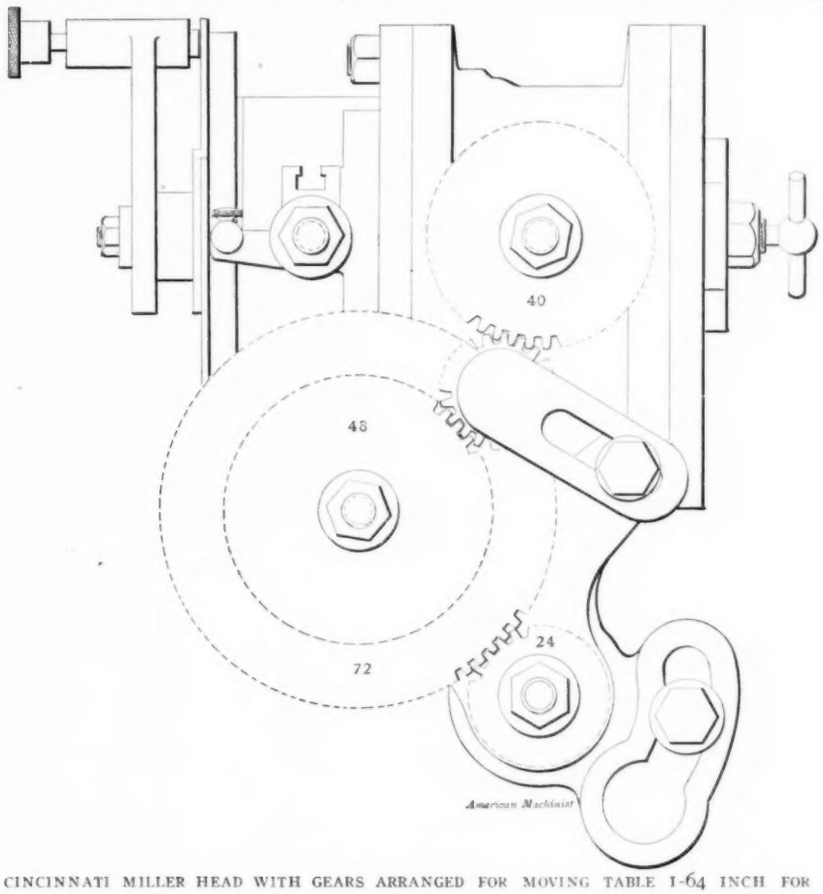
The two dies, Fig. 1 and Fig. 2, shown by Mr. L. O. Danse at page 341, should be exchanged to correspond with the descriptive matter.

Letters From Practical Men.

Longitudinal Spacing on the Milling Machine.

Editor American Machinist:

At page 197, "R. R." tells of a way he graduated some scales on a milling machine. The "trimmings"—that is, the index crank, dial, etc.—look very much like the Brown & Sharpe style; at least, these may be taken as presumptive evidence that he had a Brown & Sharpe universal milling machine at his disposal. Such being the case, he could, I think, have saved considerable unnecessary work, by simply placing the index head on the table, then putting an arbor through, as in the De Leeuw method; or, if he were very lazy, he might have stuck a 1-inch cutter arbor in the head and turned it round. That would have necessitated walking round to the column side to do the indexing. Either way, it would simply be necessary to use a 72-gear on the arbor, a suitable intermediate, and a 36-gear on the screw. Then, by using the 50-hole index plate, "R. R." would have been all ready for the job. We recently had occasion to cut forty-one slots 1-16 inch wide, spaced 13-64 inch apart, for a typewriter experiment. The job was done on a Cincinnati milling machine, by using the universal vertical attachment and holding the blank in the vise, parallel with the table. The rack cutting arbor was swung round parallel with the work and provided with a 1-16 inch saw. The index head was then put in place on the end of the table, and a 40-tooth gear put on an ordinary 1¼-inch cutter arbor. The head was then swung over, with the arbor and gear reaching out over the end of the table. Intermediates 48 and 72 went on nicely on the swivel plate. To reach the 40-gear on the arbor it was necessary to interpose the idler used for cutting left-hand spirals between the 40 and 48 gears. This was easily accomplished by the help of a sufficient number of washers, the arm being turned over so that the gear went towards the table, instead of away from it, as usual. To sum up, we obtain an advance of the table of 1-64 inch for one turn of the index crank with the following gears: Arbor 40, idler, first intermediate 48, second intermediate 72, gear on screw 24. Thus, 13 turns of the index crank gave us the required spacing of 13-64 inch. By using gears 64 on the arbor, 40 on the screw and any intermediate, we get a spacing of 1-100 inch for every complete turn of the index crank.



CINCINNATI MILLER HEAD WITH GEARS ARRANGED FOR MOVING TABLE 1-64 INCH FOR EACH TURN OF INDEX CRANK.

The following table gives a list of fractional spacings that may be obtained by gearing the index plate to the screw, making a complete revolution of the index plate for every space. All the combinations have been tried on a Cincinnati milling machine and found correct. With slight modifications they will go on any universal milling machine. These divisions require only the gears ordinarily furnished with such a machine:

Spacing.	Stud Gear.	1st Int.	2nd Int.	Screw.
1/16	32	64	28 idler	56
5/64	40	48	24 idler	64
3/32	24	idler		64
7/64	28	idler		64
1/8	32	idler		64
9/64	24	64	72	48
5/32	40	idler		64
3/16	48	idler		64
7/32	56	idler		64
15/64	40	64	48 idler	32
1/4	32	64	48 idler	24
9/32	72	idler		64
5/16	40	64	56	28
3/8	72	idler		48
7/16	56	idler		32
15/32	72	32	40	48
1/2	56	idler		28
9/16	72	idler		32
5/8	72	48	40	24
3/4	72	idler		24
7/8	56	32	48	24
15/16	72	32	40	24
1 inch	72	48	64	24

If work of this kind is done regularly, it would pay to have an index plate provided with ten notches (for Cincinnati miller) or ten holes in the largest circle (for Brown & Sharpe miller) and one plate with sixteen notches or holes. By gearing the index plate for 1-10 inch and ¼ inch, respectively, and using the sector, a spacing of any number of 1-100 inch or 1-64 inch divisions may be obtained very easily. The index pin is then used only as a handle to revolve the dial, the locking pin doing the indexing. On the Brown & Sharpe machine the index pin may be used in this way: Start with the index pin in the same hole as the locking pin, move one arm of the sector up against the index pin, then move the pin over against the other arm of the sector. To move the table, push back the locking pin, turn the index plate until the index pin is opposite the locking pin and then enter the locking pin in the hole where the index pin is, and proceed. The index pin can always be started in the same hole as the locking pin, as the turning of the index crank, with the dial locked, does not move the table.

With suitable index plates nearly any spacing may be obtained in one of these two ways, thus avoiding making a list of readings for the dial of the table feed screw, with all its possibilities of error. For rack cutting either method will be found a great convenience, as nearly everybody gets mixed up before getting through with a rack-cutting job, if the usual dial indexing method is used. I know, because I have "been there," and so, no doubt, have a good many others.

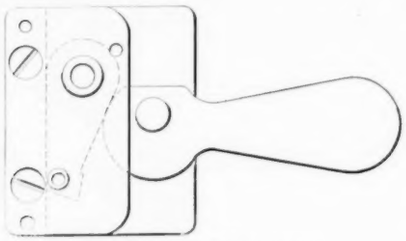
H. K. Harring.

Bushing Drilling Jigs.

Editor American Machinist:

I wish to make a few remarks or sugges-

tions in connection with the drilling jig of W. E. Callaghan at page 204. I feel sure W. E. C. will agree with me that where possible it is best to avoid fitting bushings to any movable part of a jig. Now, he has both bushings in the lid of his jig, so that in time, even though a taper pin is used for the hinge, there is sure to be a certain



JIG FOR DRILLING A PAWL.

(or uncertain) amount of play. The pawl is fixed to the base of the jig, so that with the bushings in the lid the holes may be drilled in any position except the right one. The binding screw which fastens the lid certainly makes the bushings for the time immovable, but as likely as not in the wrong place. Also, the use of three screws to be adjusted seems absurd for so simple a little thing as a pawl, when one cam-lever will do everything that is required in less than a third the time.

I should like W. E. C. to make a jig after the style of my rough sketch, and he will be able to drill more than three times the number he is drilling now, with a jig costing less than half as much to make and which will wear infinitely longer than the present one. A. L. WEEKES.

Rugby, England.

Useful Belt Tool.

Editor American Machinist:

Belt punches are expensive; it takes three or four of them to cover the usual range of work, and a hammer, block of wood and some good backing to hammer on are their essential accompaniments. The tool described herewith, though pretty old, is not so well known or so generally used as its advantages would seem to warrant.

Take a three-cornered file 6 to 8 inches long and tapering from 5/8 inch down, and grind it rounding on the back and hollow in front, as shown in cross section *A A*. At *B B*, by grinding and whetting, produce sharp cutting edges. Annealing the file

BELT TOOL.

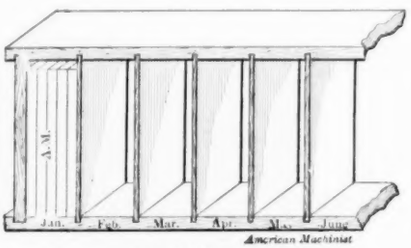
facilitates the grinding, makes the edges *B B* more susceptible to the influence of the oil-stone, and allows of drilling the 3-16 inch hole *c*, which comes in very handy in getting a hold on the belt-lace end for pulling it through. As may readily be seen, by inserting this tool into the belt and then making a complete turn with it, the lace hole is produced.

The holes made range in size from those suitable for wire lacing and produced by the point of the tool to those for 3/4-inch rawhide lace produced by the widest part of the tool. It will also readily ream small holes to a larger size. The crescent-shaped cut made by its mere insertion into the belt is very suitable for holding the end of the belt lace. Burning the tips of a belt-lace hardens them and thus gives you good working ends. G. FRANK.

Filing Unbound Papers.

Editor American Machinist:

I keep, or try to keep, my unbound copies of the AMERICAN MACHINIST in my bookcase in an upright position and in proper order, so that I may be able to refer to them at any time, and place them back in proper order with little trouble. The way shown in the sketch did the job in good shape. In the bottom of the top shelf and the top of next lower shelf I cut saw cuts spaced to take each a month's issue of the AMERICAN MACHINIST. I



FILING LOOSE PAPERS.

bought some cardboard and at my nearest tin shop got a small bundle of binding tin; what I did not use I kept for future use. I bound the cardboard at the corners, and the cardboards with the tin binding fitted the grooves in the shelves. The whole thing made a neat filing case, keeping the papers in good shape. I use the same for catalogs, making the saw cuts 3/4 inch apart. MACHINE SHOP.

Center-Punches and Prick-Punches.

Editor American Machinist:

At page 346, C. H. Norton "sits down hard" on something. It is not quite clear to my mind what he is sitting on, the "prick punch" or the "center punch." A prick punch, as I understand the term and as I use it, is a small, light variety of the center punch with an acute angle; about 20 or 25 degrees included angle. I do not grind it on a universal grinder to exactly 20 degrees; if it is 19 or 20 degrees, it answers my purpose just as well, namely: to make a light, sharply defined mark on a flat surface when laying out work. I use the acute angle because it is easier to place a fine point where it is wanted than it is to get the ordinary 60-degree-or-thereabouts center punch exactly where it should be. I believe that Mr. Norton will agree with me in this. Also the acute angled impression left by the prick punch gives a better location for a divider point, which is apt to flounder about rather indefinitely in the average center-punch mark. Center punches I use, like a good many others in my line of business, to mark the location of a hole to be drilled. The preliminary layout may have been done with a prick punch, the center punch simply being used to deepen the impression of the prick punch. The simple fact that the two styles are advertised and sold as such ought of itself to be sufficient proof that the names are perfectly well understood both by the makers and their customers, and also that each in its own particular way is usefully employed for work which the other one is not as well adapted to. H. K. HARRING.

The Shop Eye Doctor.

Editor American Machinist:

There have been some letters in your journal, recently, about the amateur eye-doctor of the machine shop, and when I remember the severe punishment I received at the hands of my friends, when I got a chip in my eye, I feel like contributing my mite to the discussion. At the time of the discovery in Germany of the anaesthetic action of cocaine, I was practicing dentistry, and became interested in the subject. I purchased a little in solution when the drug was worth $480 per ounce, and afterward used it quite a good deal in my practice, and, being frequently called on to remove obstructions from the eye, I got quite a little experience with the action of the drug on that organ. When I sold my dental practice and went again into the machine shop, I took instruments with me, and, being often operator and operatee at the same time, I gained some experience at both ends of the instruments. The following are my articles of faith as I have worked them out:

1. Instruments.—I find that what dentists call "spoon excavators," straight, and bent right and left, are the handiest instruments to use; a satinwood or snakewood handle with a socket and three spoon excavator points to screw into it make a good outfit, and they can be bought of any dental supply house for a small sum.

2. Anaesthetic.—The action of cocaine on the eye is prompt and complete, but I have learned to avoid a solution; it is like liquid fire in the eye that has become irritated or inflamed, and is severe in any case. A solution soon spoils and ought to be freshly made for every operation. I keep cocaine in a straight vial (such as gold, prepared for dentists' use, comes in) and turn out a few crystals upon a clean, white paper, then moisten the back of the instrument at the corner of the eye, and picking up one to three crystals with it—holding the eyelashes back with the thumb and finger of the left hand—lightly touch them to the eye close to the particle to be removed, and hold the eye still until they are dissolved (a few seconds will suffice). A second application in the same way will complete the anaesthesia and the burning smart is avoided. Inside of three

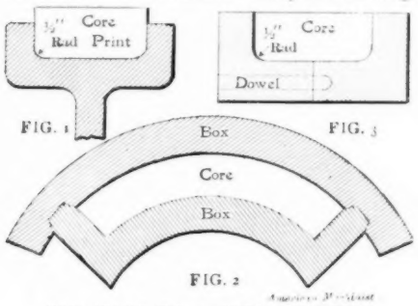
minutes the eye around the offending particle will be as easy to work upon as the thumb nail. The spoon excavator being rounded and smooth on the back can be pressed upon the eye until the edge catches under the imbedded piece, and lifts it out without wounding the eye at all. A good machinist should have a touch as light and as accurate as a good surgeon.

3. Self-Help.—I use a concave reflector that was made to be used under the stage of a microscope. It is 2 inches diameter and 2½-inch focus. By bringing the eye to the focus everything is seen much magnified and plain, and nobody's help is needed; this, to me, is much the pleasanter way. J. S. ROUNCE.

Two Ways for a Cheap Core Box.

Editor American Machinist:

The things that puzzle the patternmaker, the machinist and mechanics in general are the little details, and, by reading and studying the articles in mechanical papers, we find how others have little troubles and work them out. Sometimes we have unreasonable and unnecessary troubles; here is one: I once made a flanged wheel pattern and the core boxes for it. The rim was made with a core, Fig. 1, and the core box was made for one-quarter the circumference. The construction of this core box was the cause of trouble. Only one casting



TWO WAYS FOR A CHEAP PATTERN.

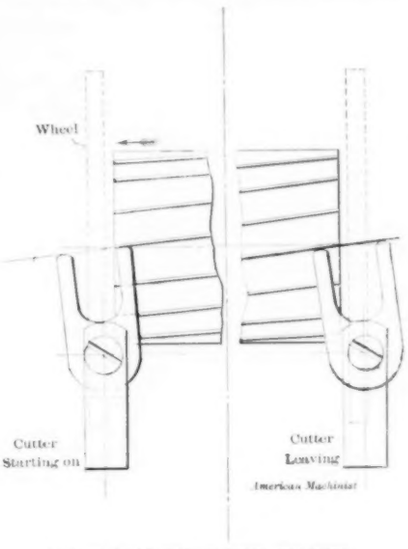
was wanted, and, knowing this, I made the box as in Fig. 2, as cheap as possible, and, as I thought, very practical. The pattern and casting were satisfactory. About eight months after, in another shop, I was given another pattern to make, in general construction about the same as the first. The pattern passed the foreman, but he was somewhat displeased at the way I made the core box, and he instructed me to make another, as in Fig. 3, saying that my way of making the core box was not mechanical, as the molder would be obliged to file the fillet off the core. In both cases only one casting was wanted and the rim was to be finished all over, so I can't see why the first core box was not as "mechanical" as the second.

PATTERNMAKER.

Cutter Grinder Tooth Rest.

Editor American Machinist:

The sketch shows an improved form of tooth rest for grinding cutters and reamers on small tool grinders. It was devised especially for grinding spiral fluted work, it being set for such work with the two bearing points in line of travel of tooth,



TOOTH REST FOR CUTTER GRINDER.

as shown; but it is of course just as advantageous for straight-fluted work.

A. B. CHRISTMAN.

Combination Tools for the Patternmaker.

Editor American Machinist:

The patternmaker's combination tools shown in these sketches cannot be carried in the vest pocket and still leave room for a dollar watch. They have some virtues, however, that will commend them to the itinerant members of our craft, and perhaps to some of the "fixtures."

Fig. 1 shows how two sizes of iron planes can be made to each serve a dual purpose, the smallest block plane *A* and the jack plane *B* and *C* being converted into sole planes for use on curved work—such as lags and circular core boxes—by filing out a dovetail at the mouth of and clear across the face of the plane, to allow space for the shavings to pass freely when used as a sole plane. It will be found that the angle of the plane iron makes it necessary to provide additional room, hence the width of the dovetail is determined by the thickness of the soles used, which should never be more than ⅝ inch on the jack plane and 5-16 inch on the block plane of the size shown. At *C* is shown the dovetail fitted with a piece of cast iron or steel so that the plane can be used as originally intended. The "tadpole" holes shown at the ends, and used to fasten the soles to the body through the medium of button-head screws, are not of sufficient size to cause trouble when "jacking" stock. In making the soles, leave enough stock at the ends so that after fitting to match the tadpole holes, lines can be scribed to conform to the shape of the plane outside, and to the width and length of the mouth inside.

Fig. 2 shows a tool that also is a space saver, as it can be used as a surface gage, straddle gage, depth gage for lathe work, panel gage and router. The body or base is made of hardwood 7½x2x1 inches, with three ½-inch holes drilled through, one in the center, one ¾ inch from one end, and one 1½ or 2 inches from the other. The purpose of spacing the end holes differently is to provide for the innate cussedness of inanimate pattern work. The sketch shows the tool as used for a surface gage. Without dismantling it will prove itself a straddle gage as well, for scratching lines on surfaces inaccessible to the ordinary scratch gage, by using the upper face of the body and adjusting the scriber bar to the desired clearance for hight. If a fine adjustment of the scriber point is wanted, bend the bar slightly at the center; then, by turning the same around by the aid of the right-angled end, almost any adjustment can be obtained. By slipping off the sliding clamp, a depth gage for turning deep work of small diameter results, and by substituting an extra long beam for a panel gage, and with the usual shaped cutting tool for a router set in either of the three holes. It will be seen at a glance that this is a handy tool to own. The gage beams should be made of ½-inch brass pipe, and ordinary slotted head steel wood screws are good enough to clamp the same to the body. OLD BOB.

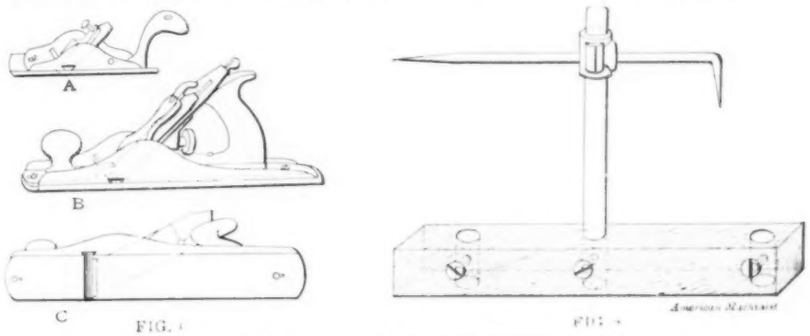


FIG. 1 FIG. 2

COMBINATION TOOLS FOR THE PATTERNMAKER.

Gaggers.

Editor American Machinist:

Mr. Thos. Wathey, at page 188, does not agree with me that it would pay to use wrought iron or mild steel gaggers, except for special work. Let us examine this. I suppose that in gaggers it is not quantity we want. In fact, it seems to me that the less quantity of heavy material we

have, the better, on account of having to lift it about. Of wrought-iron gaggers we shall not need to use more in number than of cast iron, and as the wrought ones may safely be made of a section one-third of that of the cast iron, the material cost will be less if anything. As to the labor in making them, this would not cost greatly more, as only a few blows in cutting and bending are required, and unskilled labor is cheaper than skilled. Better set the molders to cast up sash weights in their "resting" time. The wrought gaggers are much better to handle, and the men will take better care of them; just as a machinist will clean and keep in order a nicely finished tool, whereas a tool of poor appearance is as a rule despised and ill-used.

FRANCIS W. SHAW.

Stops for Screw-Machine Chucks.

Editor American Machinist:

It was the usual practice in the shop where I worked at one time to make back stops for screw-machine chucks as shown in Fig. 1. It happened at times when the stop was made that the distance *a* was either too short or too long, which necessitated either the addition of a washer

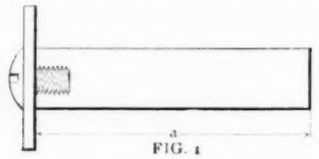


FIG. 1

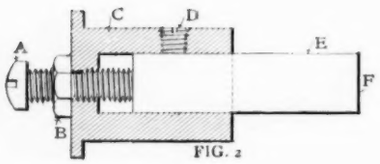


FIG. 2

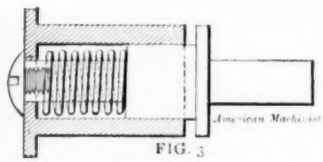


FIG. 3

STOPS FOR SCREW MACHINE CHUCKS.

of the proper thickness under the head or the shortening of the stop. I finally got up a simple device shown in Fig. 2. Screw *A* permits end adjustment of stop *E*, check-nut *B* being tightened after adjustment takes place. The body *C* is made of machinery steel fitted loosely to the body of the chuck; *D* is a headless screw to prevent *E* from slipping out when being adjusted. Pieces *E* were kept in stock, of uniform length and diameter. When there was an immediate call for a stop, all that was necessary was to finish the piece *E* at one end to conform to the work in hand. It will be evident from the aforesaid that the body *C* is adapted for a great variety of pieces *E*—whatever their shape may be at *F*.

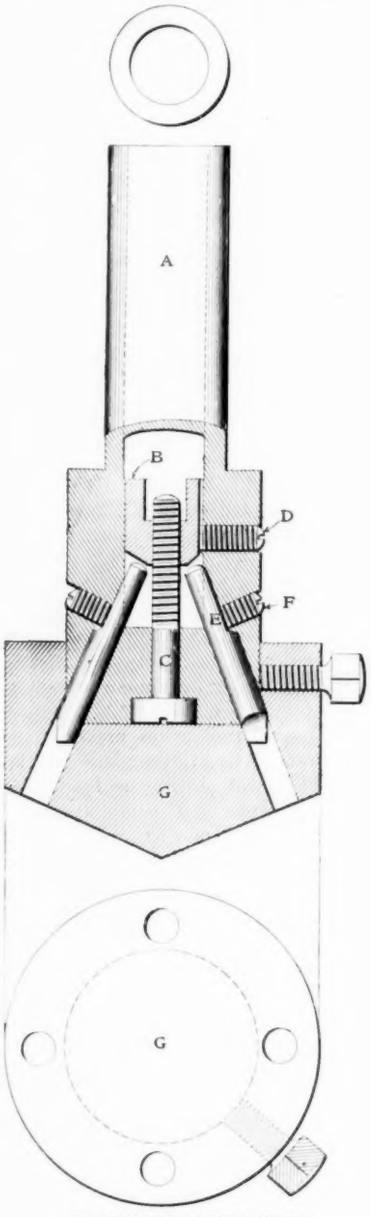
Fig. 3 shows a form of stop which needs no further description than to say that while acting as a stop operated either with the hand by pushing the work against it, as the spring can be made of a light tension, or by bringing the turret up against the work, it also ejects the work when the chuck is opened.

G. L. E.

An Expanding Cutter Head.

Editor American Machinist:

The enclosed sketch shows an expanding roughing cutter. *A* is the shank which fits the turret, and is bored to within about



EXPANDING CUTTER HEAD.

⅞ inch of the end; *B* is a plug with conical front, fitting freely within the hole. It is tapped ¼ inch to receive the adjusting screw *C*, which is let in through the front flush with the holder. Plug *B* has a keyway through its length, the pin *D* acting as its key and causing it to move lengthwise as the screw C is turned. *E* is pieces of ¼-inch round steel let in at a convenient angle and having flats filed for a certain distance for the binding screws *F* to keep them in proper position only, as the adjusting plug is very effective in keeping the cutters from being forced back. *G* is a jig for drilling the holes in the holder. All screws being flush with the holder, it is a very neat and economical tool.

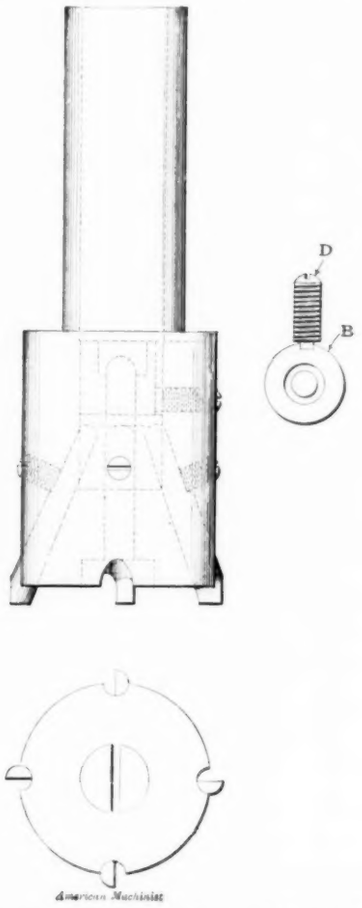
W. REYNOLDS.

Birmingham, England.

Magnetism in Press Work.

Editor American Machinist:

I was much interested in Mr. W. Hughes' article, "A Magnetic Trick," at page 197, as I have often wondered why magnetism has not been brought into use on power presses and the like, especially



those on small work such as making and drawing metal cups, etc. I was working in a manufactory a few years ago where a large number of such presses were employed for drawing round bottomed cups or shells, these being fed along by hand by girl operators, the method necessitating a certain amount of attention coupled with the risk of the girls occasionally getting smashed fingers through carelessness in feeding them along.

Now, why should not a magnetic arrangement be devised by means of which

the cups could be drawn under the ram one after another, a sort of magazine feed in fact, with magnetism as the "feed," the cups being merely placed in rows or in any convenient form and drawn under the ram consecutively? This would certainly avoid danger and would save labor and time. S. H. G.

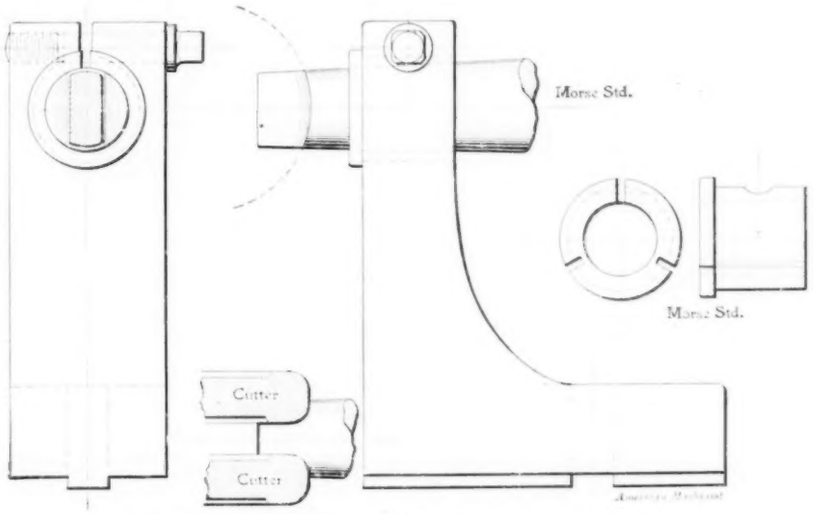
Coventry, England.

A Fixture for Holding Taper Shanks while Milling the Tangs.

Editor American Machinist:

In most shops a very common job to be done is turning taper shanks on arbors, drills, chucks, reamers, etc., and forming a tang on the end. The device here presented is for holding the shank while milling the tang.

The knee is of machinery steel and is rigid enough to support the work and stand the cut. The hole for the bushing is in line with the spindle hole in the index



FIXTURE FOR HOLDING TAPER SHANKS WHILE MILLING THE TANGS.

head of the No. 4 Brown & Sharpe universal milling machine. One ¾-inch bolt is sufficient to secure the fixture to the table. A split bushing bored for each size shank is provided, and in use is closed by the clamp, and can be held. The operation is done at one pass of the cutters.

H. E. B.

Justice to Self.

Editor American Machinist:

One of my numerous hobbies—if you don't call them crankinesses—has to do with practical justice, and the AMERICAN MACHINIST has touched me upon that point—either patted me on the back or trod on my toes—in a recent issue. At page 357 we read about the Adams Memorial Gear Cutter recently given to the University of Illinois. The story of the young man who worked so recklessly, so foolishly, as to impair his health and then destroy his life, is among the saddest that are told, and none the less sad that so many similar ones are heard of. That memorial gear cutter may stand evermore for two very different things, and I have not the slightest doubt that it would be better and more profitable to have it stand for the thing indicated in the editorial remarks which accompanied the announcement of the very commendable gift. When you get right down to the bottom of the story of the overworking of young Adams, it does not seem to be anything but a bare, simple case of injustice, and I say this without the slightest suggestion that the injustice was on the part of his employers. He simply used himself unjustly, but the injustice is no less pronounced and no less reprehensible than it would have been if others had been the perpetrators of it. It is generally assumed or conceded that a fellow has a right to do what he will with his own, but it is a mistake to cover with this general formula the right to squander one's health and life, for these never belong entirely to the individual, and by such recklessness none ever gets the most or the best of life, either for himself or for those to whom he owes some duty. When one pays all of service that is due, the giving far beyond that, whether impulsive or deliberate, and to one's own impoverishment is not to be called a wise or profitable act. It is, as the editorial note suggests, a mistake and a wrong to commend the reckless squandering of self in extravagant zeal of accomplishment. Let Polonius constantly remind us:

"To thine own self be true,
And it shall follow as the night the day
Thou canst not then be false to any man."

I didn't set out to preach, but now that my sermon is under way bear with me, brethren, while I "improve the occasion" with a few additional remarks. In the matter of justice to self, there are sins of omission as well as of commission. I can call them mistakes instead of sins if anyone will be better suited, but mistakes in life are punished as heavily as the worst of sins, and it is not to be supposed that they get more than they deserve. These omissions probably on the whole entail the greater loss, rather than the commissions. I have known many fellows in the shop and have noted quite a considerable portion of the life careers of some of them. Some I have seen to prosper and get ahead, and some others have either just held their own or have gone backward. Circumstances have of course played their part, but none have ever advanced continuously by accident alone. The looking out for justice to self and the doing of constant justice in the service of self have had lots to do with it.

To begin with, it is a misfortune to a young fellow, or to any other fellow, to have a boss who is not in theory and practice, consciously or unconsciously, just to himself, who does not look out to get what is due him from those he employs. A slack boss is a fraud upon himself and a promoter of injustice all around, while a sharp boss not only secures to himself what he otherwise would lose, but stimulates all who come in contact with him to do the best for themselves. Suppose, now, a fellow has a boss who knows what is right, or what his rights are, and who looks out for them. In such a case anyone who works for him is evidently unjust to himself, or is not doing the best to help himself along, if he is not just also to the boss in the matter of time. If he is frequently and habitually late in coming into the shop or is dawdling in starting up his machine and getting to work, and if he begins to get ready to quit ten or fifteen minutes too soon, so that his work is not kept fully going, he evidently is not just to himself or he is not making the best showing of himself or advancing his standing with the boss. The same thing applies in the matter of personal appearance and in the cleanliness and neatness and the convenience of arrangement of all the tools and appurtenances of the job. So far as the boss takes notice of these things, and he ought to notice them minutely and constantly, the man who does not make as good a show for himself as possible is evidently not doing himself justice. In the olden time when each lathe hand or planer hand had his own full set of tools for the machine and used to go to the blacksmith and wait to have them forged or tempered, and then did all the grinding of them and keeping them in working condition, there used to be a great difference between men as to the time that would be lost by this costly arrangement. Some would never have a tool in condition to use except the one actually in the machine, and with every change there would be a wait at least for the grinding and often for a loaf with the blacksmith, while others would take advantage of the times when they would have a cut running and get their tools dressed and ground so that the next tool wanted would always be ready for instant use. The latter class of men were most true to themselves and in

the long run secured better pay, steadier jobs, or promotion to more lucrative positions. Now that we have toolrooms with tools always ready for anybody for any purpose upon call, and a messenger service with electrical calls and all the rest of it, there is still the difference in the men. Some can and do think ahead far enough to have the next tool at hand before the actual minute comes to use it, while others have to wait with every change of tool. Here again one is more just to himself than the other. There are so many cases in the shop where this matter of justice to self by promoting one's own efficiency or productiveness comes in that it is not worth while to try to enumerate them. Perhaps one of the most important is in the changing of lathe speeds when the diameters of the work change and the changing of feeds as the cuts become much lighter or heavier. Often on planer work that is not rectangular much time is saved by moving the dogs when the shorter portions are traversed, but the men who are not the most true to themselves are apt to neglect it.

No foreman who is fit for his job has any too easy a time of it, and foremen, like everybody else, like to have as easy a time as possible, and they of course like best the men who give them the least trouble. It need not be said that there is a great difference in men in this respect. Some of course are not as good as others simply because they can't be, and they don't come into this sermon, but others differ from each other by actual effort and thought in the one case and by the lack of it in the other. The one who is just enough to himself and to the foreman as to so think and plan that errors will be avoided, that everything will be done right that is done and that nothing will be omitted that should be done, must have a better present and prospective standing than the one who unjustly avoids all thinking and planning and so brings trouble and avoidable work and delay. Assuming all the while that a fellow wants to do the best that he can for himself, the only way yet discovered for him, so far as I know, is in this line of justice to self.

TECUMSEH SWIFT.

Two Sizing Tools.

Editor American Machinist:

I enclose sketches of two tools which we have found very useful. Fig. 1 is a sizing tool for piston ring grooves. The tool is used on a boring mill, the groove being first roughed out with a light cut remaining on both sides for this finishing tool. Several grooves can be finished before the tool needs readjusting. This tool was made from our design by The Mergenthaler Company, using their standard reamer screws and blades, except that the blades are not spotted for screws, but are beveled the full length. The tool shown in Fig. 2 is used on a slotting machine to cut out boxes for their caps, as shown at the right. In roughing out we use two cutters, laid one on each side, parallel to shank of tool. In finishing we have cutters ground to exact length, which are placed crosswise in the holder. In this way we secure uniform work without the use of calipers. The cutters are flat pieces, $\frac{3}{8}$x$\frac{3}{4}$ inch, ground to size in the toolroom.

ISAAC MORGAN.

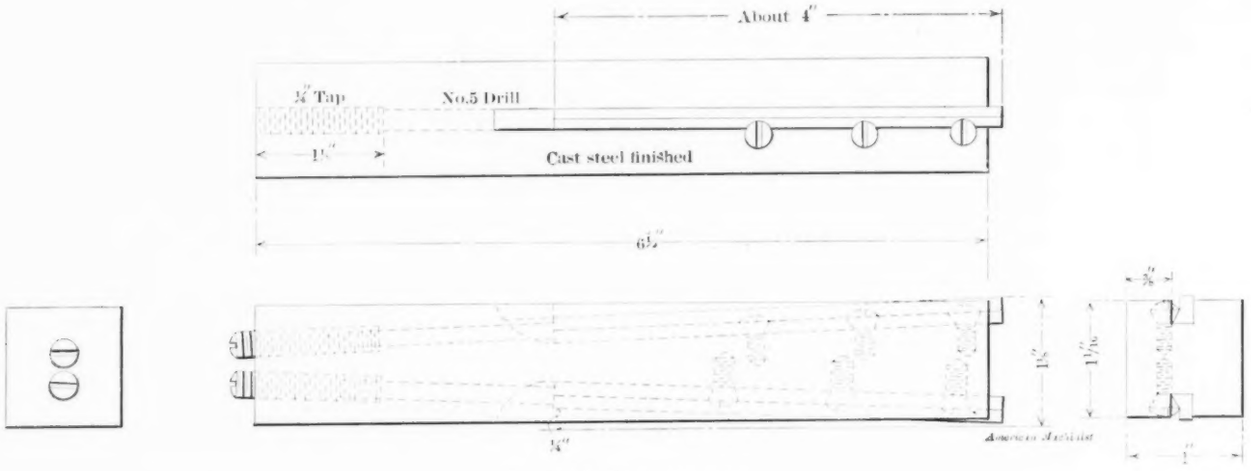


FIG. 1. GROOVE SIZING TOOL.

A Suggestion in Mechanical Nomenclature.

Editor American Machinist:

What has been said about sizing sheet metal blanks for drawing has certainly been interesting and instructive, but one cannot help noticing the very different meanings associated with the common word "stamping" by the various writers. Another word that is being abused by the builders of electrical machinery is "punching." Men call a plate for a laminated pole or an armature a "punching" who would be horrified if someone should speak of a shaft as a "turning" or of a hole as a "drilling," and they would probably inform you that "turnings" and "drillings" are the waste chips or scrap from the lathe and the drill.

This lack of uniformity is also very noticeable in the catalogs of the leading builders of sheet metal working machinery, each of whom seems to have his own particular names for the various press parts and for press work as well.

Practical men cannot be expected to use words as accurately as some others who necessarily give such matters more attention, but I think that a general discussion of this matter would be a benefit to many of us. I do not wish to set myself up as an authority, but will suggest that "stamp-

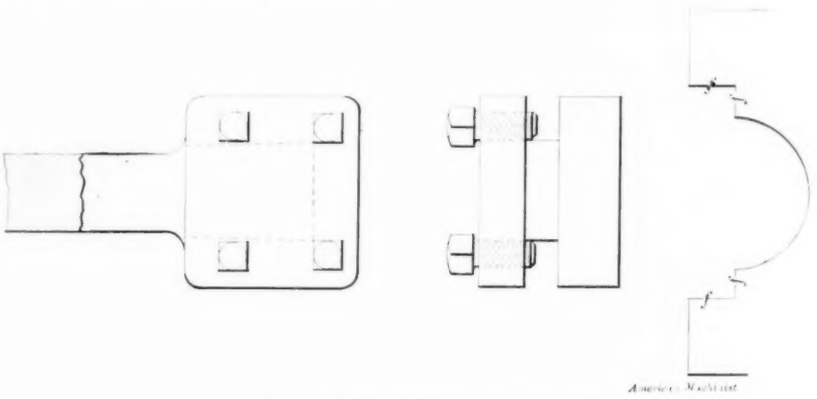


FIG. 2. SIZING TOOL HOLDER FOR THE SLOTTING MACHINE.

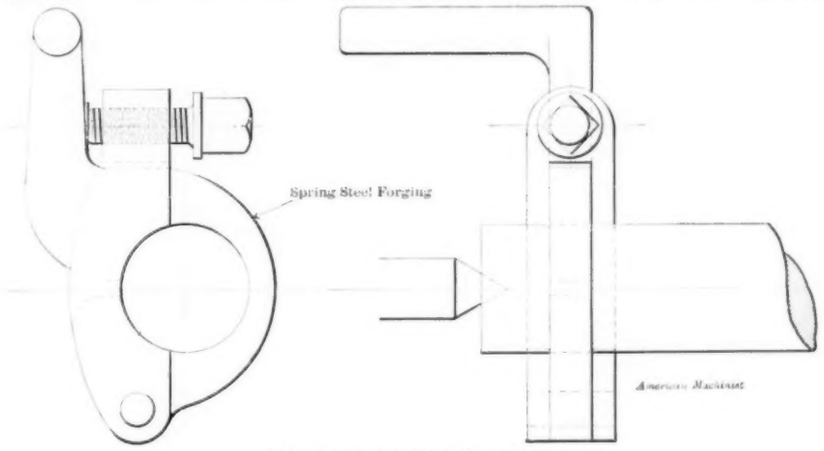
ing" is a general word meaning pressing by power work of almost any kind, as distinguished from hand work, and that it includes blanking, forming, punching, drawing, embossing, etc., and that punching means perforating or producing a hole where the hole is the thing sought for, and the piece pushed out is usually waste scrap.

R. J. D.

Lathe Dog for Finished Work.

Editor American Machinist:

The enclosed drawing shows a lathe dog designed to take some standard size rod or shaft that has been finished or polished; it will hold it firmly and without a scratch. By turning the set-screw it will close on the shaft in a manner that is surprising. It can obviously be made to fit a taper that has been turned and will hold and drive powerfully. C. W. PUTNAM.



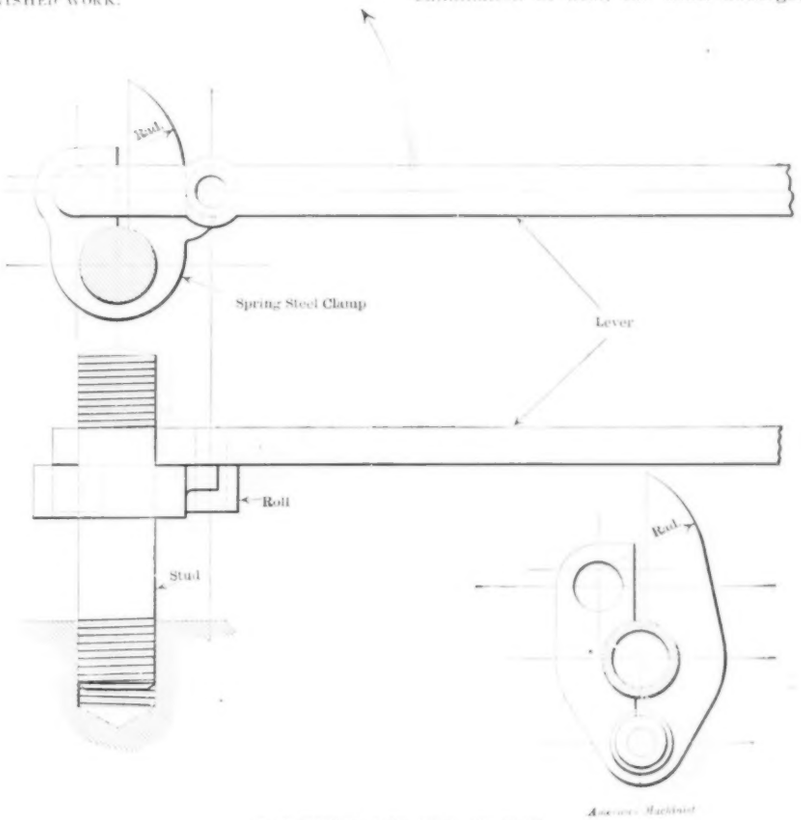
LATHE DOG FOR FINISHED WORK.

Stud Driver and Finished Pipe Wrench.

Editor American Machinist:

I enclose a sketch of a stud driver and pipe wrench. The stud driving device is so arranged that by turning in the direction of the arrow the lever and roll will cause the clamp to squeeze the stud, and the more pressure is put on the lever the more compression we have on the stud.

By turning the lever in opposite direction the clamp will be released, then continue as before till stud is extracted. By turning driver over on the other side the stud can be driven in place. The pipe wrench shown below and at the right is used with the same lever as is used with the stud driver. C. W. PUTNAM.



STUD DRIVER AND PIPE WRENCH.

Surface Grinding.

Editor American Machinist:

In presenting the following results of experience with surface grinding, I do not claim to point out the way to obtain absolute accuracy, but am confident that the hints here given will be of use to many in the effort to reduce the error limit. Best results are to be obtained only by the exercise of good judgment on the part of the operator, as a little "horse sense" is one of the qualifications for the work.

I believe that much of the trouble experienced with grinding machines is due to the use of unsuitable abrasive wheels and to a desire to force the wheel beyond its limit. It is also well to bear in mind that the size of the wheel bears an important relation to the successful removal of stock, and that heating is not necessarily harmful to the work if it is distributed evenly.

In doing precision surface grinding every operator has doubtless run up against the following difficulties: In grinding wrought metal (especially machinery steel), difficulty is often experienced by the work showing a convex surface even after a very light cut has been taken. Sometimes when using the same wheel on the same work, the latter will show a concave surface. A chattery surface is a very common trouble experienced. In starting a light finish cut it sometimes happens that a cut .001 inch deep will run out after a few strokes.

Taking up, first, the case of the convex surface, the operator would be apt to jump at the conclusion that the trouble is due to absence of water on the work or that a strain had been relieved in the work by the cut. If the emery wheel be carefully examined, it will be found probably that it is more or less filled up with particles of the metal and that these particles have in a measure transformed the wheel into a friction disk, the particles of metal rubbing down the surface of the work, forming a crust with an effect like peening to stretch the surface and cause it to become convex.

Now, in the second case, where the reverse happens, there is a seeming paradox. The explanation is that the wheel has been forced to cut beyond its limit and that a good deal of heat has been generated, causing sudden expansion of the work immediately under the wheel where it is laboring the hardest. This of course causes the wheel to cut deeper at this point. As the wheel has gained added momentum at the starting end of the work, it enters on at each end without much heat. When it is well into the midst of its cut, there is a culmination of heat, the work undergoes a temporary expansion, and the wheel cuts deeper.

The remedy in the first case is to use a softer wheel, taking light cuts with coarse feed. In the second case, do not try to force the grinding wheel beyond

its limit, or if you must use the grinder as a stocking-out machine, you must employ the freest cutting wheel obtainable.

Chattery work is due to several causes, any one of which will cause the trouble. First, a poor cutting wheel; second, an overworked wheel, and third, a machine lacking in rigidity. Also slack in the spindle will tend to encourage vibration. An entirely smooth surface is difficult to obtain with grinding machines or indeed with any machine, but a close approximation can be obtained by observing the following rules:

Take up all slack possible in the spindle, true the wheel frequently and run light cuts. The wheel must be given time to remove the metal and the smaller the wheel the more time required.

Improved results are generally obtained by reducing the width of the wheel face. I usually bevel each side about 30 degrees, leaving about ¼ inch more or less for the cutting face. The more pressure required to hold the wheel to its work, the more trouble with chatters; hence use wheels that will cut freely. Never let the wheel wear much tapering on the face. To prevent this, feed the platen or wheel backward as well as forward. The result of this will be that the face of the wheel will assume gradually a rounded contour. This is better than to have it wear tapering or rounding on one side only and wedge on to the cut.

A special truing diamond should be added to the equipment of a surface grinder and should be arranged to be held on the platen directly under the wheel and be fed under so that the wheel face may be made parallel to the work face. It is a good plan to true the wheel just before taking the finish cut on very fine work.

We will now suppose that the operator has mastered all the above details, has his wheel trued off and wishes to grind off a finish cut of a fraction of a thousandth of an inch in depth. He sets the machine in motion and everything starts off well for a half dozen strokes, when the cut suddenly runs out. I wonder if it ever occurred to this operator that oil must necessarily occupy some space and that a spindle must necessarily have oil between it and its box; also, if a spindle be stopped, that this thin film of oil must gush out somewhere and the spindle settle down somewhat on account of its weight? This is the explanation of the mystery. The moment the spindle is stopped it commences to settle and in its lowest position the wheel should not be adjusted to the work. When the spindle starts up, it gradually rises on the film of oil again. The remedy for the above trouble is simply to let the machine run for a minute before adjusting for the finish cut.

The result of the foregoing is embodied in the following "hints" for surface grinder operators:

First, make sure that the machine is lubricated and that it runs freely in every part, especially in the emery wheel adjustment.

Don't expect to adjust the wheel to fractions of thousandths of an inch without rapping on the index handle.

Select an emery wheel of as large a diameter as possible and one that is coarse and free cutting.

On tough, tenacious metals like wrought iron, machinery steel or brass, the best results in respect to finish are obtained by the use of fine soft wheels taking very light cuts with coarse feed. The wheel must wear away somewhat to insure good results.

A small wheel must not be expected to do the work of a large wheel in the same time; finer feeds and slower platen speeds should be employed for small wheels.

A grain of emery has the capacity for performing a certain definite amount of cutting before disintegration, hence two grains of emery in a wheel will perform double the work of one and the latter will change its diameter twice as fast and produce work less accurate.

Speeding up an emery wheel helps to keep it from wearing away, but the amount of the advantage is limited by practical considerations.

A glazed or a filled wheel can sometimes be remedied by slowing it down and thus forcing it to wear away.

Avoid generation of heat as far as possible, although heat does not necessarily cause work to spring. All grinding wheels heat more or less and little trouble will be caused by it if the heat is distributed evenly throughout the work. It is intense heat at one point that causes trouble.

Where much heat is likely to be generated, employ coarse feeds and very light cuts and thus distribute the heat quickly.

A cut .001 inch deep is a large cut for a finish cut.

A cut .0001 inch deep is appreciable and looks larger, judging by the sparks.

On precision work, always let the machine run idle for a minute before adjusting the wheel for the cut.

The down feed must work easily to obtain best results.

Keep all wear of spindle taken up.

Do not oil the grinding spindle in the midst of a cut. It will make a jog in the work.

Coarse wheels of proper texture cut smoothly.

The keynote of satisfactory grinding is "Free Cutting Wheels."

Remember that the grinder is primarily a finishing machine—not a stocking-out machine.

FIG. 1

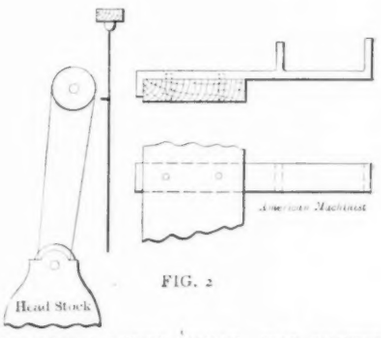


FIG. 2

SUPPORT FOR LATHE CHUCK—BELT SHIFTER.

Water is useful on a grinding machine only for its cooling qualities. It does not prevent the work from springing.

Worcester, Mass. O. S. WALKER.

Support for Lathe Chuck—Belt Shifter—Tool Holder.

Editor American Machinist:

"Old Dan" has been running an 18-inch lathe for forty years and ought to have it down fine. Perhaps some of our young machinists may be interested in a few of his kinks. Fig. 1 is a piece of 2x½-inch

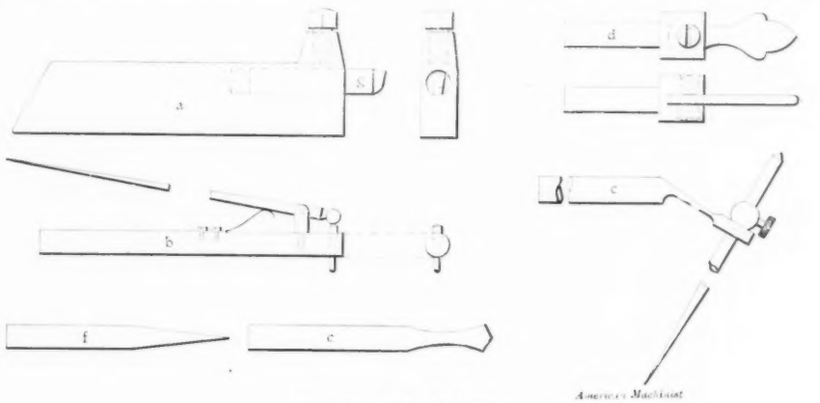


FIG. 3. TOOL HOLDER.

iron (Dan had leather riveted to his so as not to mark the chuck) with a hook turned down on one end to fit the slot in the lathe carriage, and a piece *a* riveted loosely at the other end. This fixture, when laid across the carriage as shown, is just the right hight for his 18-inch face plate, and with piece *a* swung round on top of the carriage the bar is the right hight for the 16-inch chuck, so that one man can run either this or the face plate on and off without

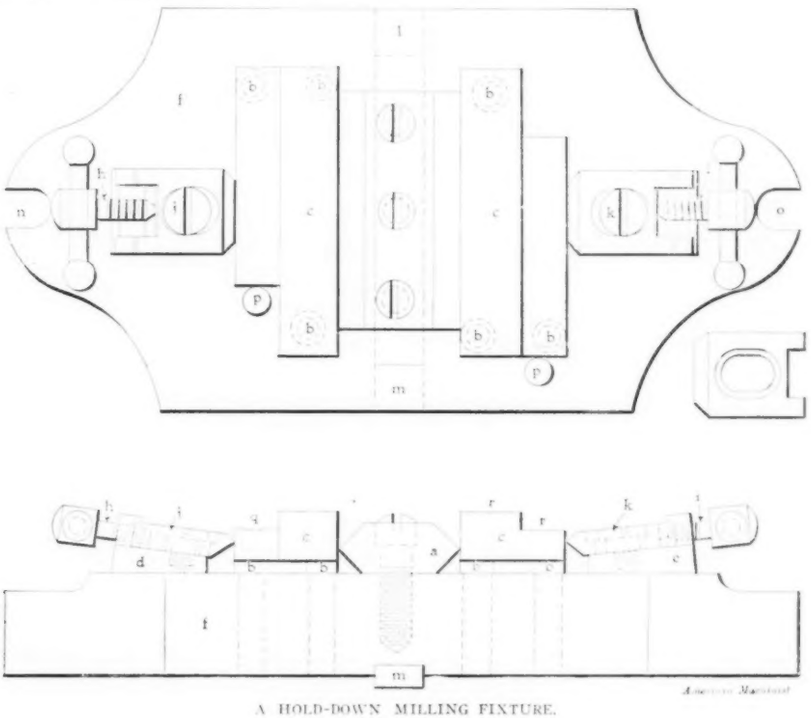
assistance. He also has a belt shifter (Fig. 2) which has rendered efficient service for the last twenty-five years, and in some cases it would answer as well as the most approved device of to-day. As will be seen, it is merely a pole hanging back of the cone, and, as the belt is slightly inclined and the pole hangs straight, the end comes just back of the lathe head. The pole carries an iron hand just where it can be swung in to grip the belt below the upper cone. Dan throws off his belt every night; in this way it is allowed to shrink, and he only sews it once in two years. The tool-holder in Fig. 3 is used for a number of purposes; the hole is round so that in cutting square threads the tool can be swiveled and so answer for either right- or left-hand screws. The indicator *b* is very convenient for rechucking work. The center indicator *c* is a copy of one illustrated in the AMERICAN MACHINIST about twenty years ago, except that this is adapted to this holder. The attachment *d* is used when setting the lathe for turning a taper to a sample arbor or reamer. The sample is held in the centers, and the rest is advanced until the acorn-shaped blade just touches the sample; the blade is then turned up out of the way and the carriage run to the other end of the sample, the taper being adjusted until the pointer just touches at both ends.

ISAAC MORGAN.

A Hold-Down Milling Fixture.

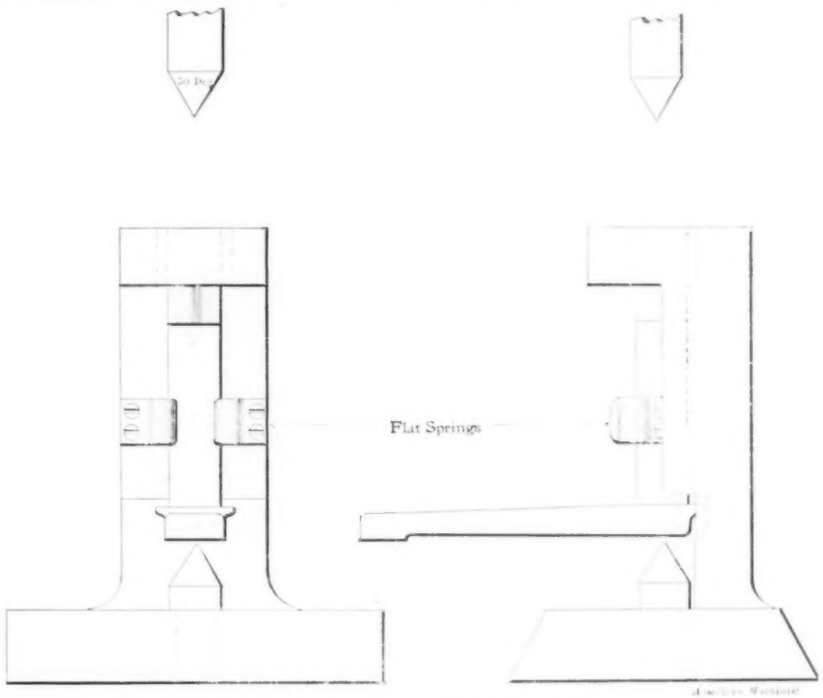
Editor American Machinist:

I send herewith sketches of a milling fixture for milling two pieces simultaneously. The principle is largely used here and gives universal satisfaction. Many ways in which it can be used will almost instantly suggest themselves to the reader.



A HOLD-DOWN MILLING FIXTURE.

The knife-edge stop *a*, of hardened tool steel, is fastened to the cast-iron base by the three screws and two dowel-pins, the latter not shown. The six pins *b*, also of hardened tool steel, serve as supports for the work *c* while being operated on. The two clamps *d* and *e* are held down in place by filister head screws, not shown, passing through the cast-iron plate *f* from the bottom. These clamps consist of a wedge-shaped piece of steel with a lug on the wide end and planed all over. The lug is finished the width of the opening in the clamp, detail *g*, and the clamp is fitted to slide freely on it. The end lugs are tapped, and the screws *h* and *i* are fitted, and the holes for the screws *j* and *k* are drilled and tapped. These screws serve to hold down the clamps and slide in the elongated holes, which are recessed so that the heads of the screws are flush with the surface. After hardening the clamps



FIXTURE FOR CENTERING IN THE PUNCH PRESS.

the fixture is assembled and placed on the milling machine with the blocks *l* and *m* in the tee-slot of the platen and held down by two bolts in the slots *n* and *o*. The parts *c* to be operated on are now dropped on the pins *b* against the pins *p* which take the end thrust. The screws *h* and *i* are tightened, which forces the work down solid on the pins *b* and also against the knife-edge stop *a*. A gang of cutters is now run over the work, machining it at *q* and *r*.

W. E. CALLAGHAN.

Centering Work in the Punch Press.

Editor American Machinist:

The sketch enclosed shows a device that was used for centering a drop-forged bicycle crank of the two-piece variety. Some may object to this method of centering, because there is no small hole at the point; nevertheless it answered very satisfactorily in this case, and it was very easy to get centers that measured a quarter inch across the top, and this in turn answered nicely for a start when drilling a hole clear through, half way from each end.

The bushing in the top of the fixture might have been left out. It took less than a day to center the 10,000 cranks, and this bush was probably never used again. The forging was slipped between the flat

springs which held it against the groove in the fixture.

There are three points in favor of this manner of centering: (1) quickness, (2) the centers are exactly in line, and (3) the centers are a definite distance apart.

There is no question in my mind that a different shaped center pnuch could be used to overcome the objection cited.

H. G.

Grinding Twist Drills for Cutting Air.

Editor American Machinist:

Having had a lot of holes to drill in which part of the drill cut air as shown in the sketches, I had some trouble in drilling the holes straight with the ordinary drill, the tendency being for the drill to shy away from the metal, as shown in Fig. 1. After grinding the drill as shown in Fig. 2, I found it as easy to drill the holes straight as if drilling a full hole.

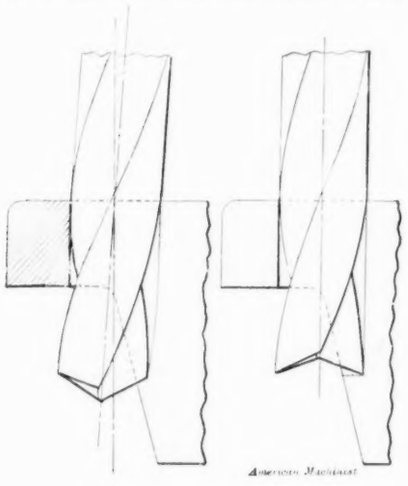


FIG. 1 FIG. 2

GRINDING DRILLS FOR CUTTING AIR.

In order to start the drill, it is necessary to use an ordinary drill, drilling just deep enough to enter the blades of the drill as ground in Fig. 2, or a jig may be used to guide the drill in starting. I have been able to do some very difficult drilling in this way, even to drilling less than a half hole, or where more than half of the drill cut air.

W. KRAMP.

Making Button Head Screws.

Editor American Machinist:

Some time ago, I happened to be located at a small electrician's as "general engineer." To repair a rheostat we required some button-head screws. The sketches tell the tale as to how these were made in short time. One-eighth-inch diameter brass wire was cut into lengths and threaded in the lathe, one end short and the working end long. Upon the short threaded end was screwed a brass washer (tapped) as shown in Fig. 1. The apparatus for making the rounded head is shown at Fig. 2. This consists of the half of a copper float ball mounted upon a three-legged stand and containing solder. A small circular gas burner, a can of cleansing material made up of resin and spirits, and a can of clean water complete the outfit.

To make the button-head the brass wire with washer head was dipped, washer down, first into the cleansing paste and then into the molten solder, causing a drop to form upon the bend, and also to solder the head fast to the wire; then into the water.

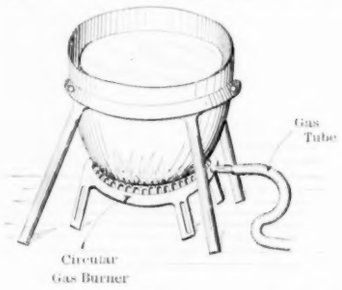


FIG. 2

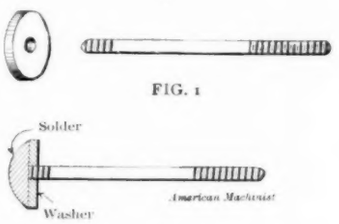


FIG. 3

MAKING BUTTON-HEAD SCREWS.

Dipping the molten drop into the water caused it to partake of a perfect button-shaped form, so well formed that it gave the bolt a nicely finished appearance, needing no finishing whatever. (See Fig. 3.)

FRANCIS W. SHAW.

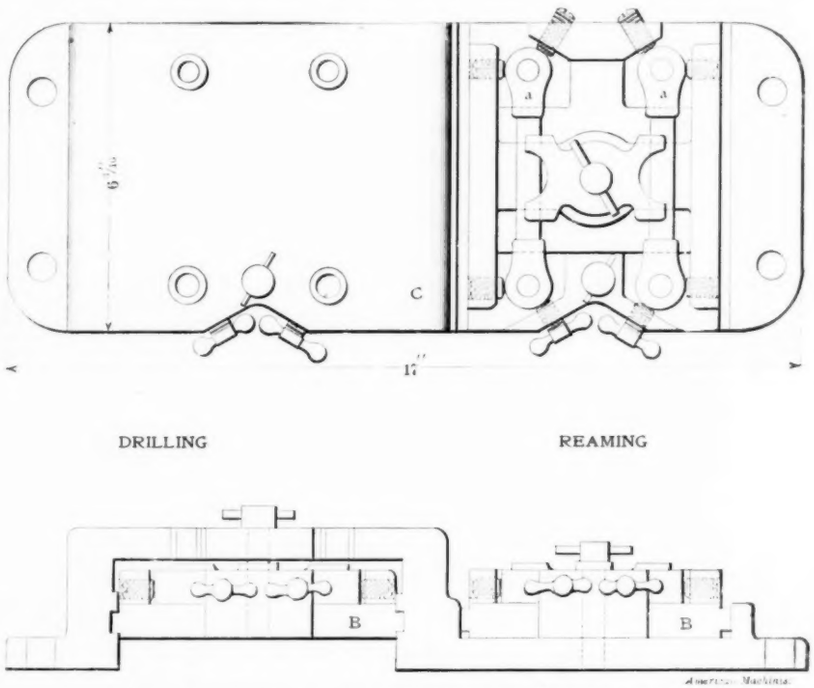
Birmingham, England.

Jig for Drilling and Reaming Links in an 8-Spindle Drill.

Editor American Machinist:

The drawing shows a jig which is used for drilling and reaming connecting links, and which helps to keep our multiple spindle drill presses working with nearly their full number of spindles at all times; in most shops I find that the number of pieces that can be worked up on such tools, and keep a reasonable number of spindles working on a piece, are not sufficient to keep them busy; hence the adoption of jigs of this principle, in which the removing of bushings for reaming is avoided and the labor cost reduced about one-half. The links to be operated on are shown at *A A* clamped to a plate or body *B*. There are three of these plates, two being held in the jig frame *C*; and, while the tools are operating on the links in these, the third plate is being refilled.

W. E. SARGENT.



JIG FOR DRILLING AND REAMING LINKS ON 8-SPINDLE DRILL.

Every Man His Own Eye Doctor.

Editor American Machinist:

In view of the letters on the "Shop Eye Doctor" which have appeared recently, I would like to relate an experience of mine when there was no such "doctor," as it may help some other reader of the AMERICAN MACHINIST.

In the course of the day I had got something fixed in my eye which made it very painful, so on leaving for the day I went to a doctor—not a shop eye doctor—to have it got out, and paid him a fee of $1 for the said getting out. But, upon arriving home, in a little village without a doctor, my eye was as painful as ever.

With a light and a mirror I soon located the offending substance. Now to get it out. My wife was too timid to try. I tried myself, but my eye was by this time so painful that I could not hold it still when the lance was near it. This led me to think that if I could manage to fix the eye immovably for a few seconds I could do the job. How to fix it was the next thought. This was soon and simply done by opening the eye and the wife pressing on the lids with one bow or handle of the scissors. Needless to say the job was soon done, and done well, too, without cocaine, either. MICRO.

Birmingham, England.

Business Ends of Twist Drills—Cutter Grinder.

Editor American Machinist:

It seems to be natural for a boy, when he begins to run a drill press, to feed the drill according to the force required to keep it cutting. That is, if it cuts freely he feeds it fast, and especially so as the drill points through the work, and it is here that the drill is most frequently tested to destruction, or sometimes only its tongue is twisted off.

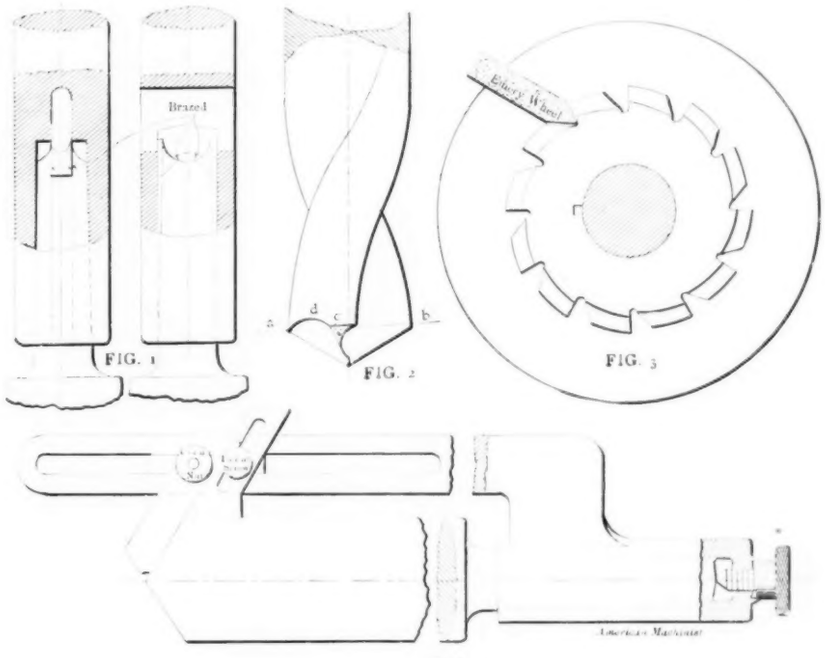


FIG. 1 FIG. 2 FIG. 3

FIG. 4

TWIST DRILLS—DRILL GAGE—CUTTER GRINDER.

Automatic feeds and balanced spindles relieve the breakage of drills to a great extent, when they are allowed to do so, but once in a while a man unaccustomed to drilling stops the feed when he sees or feels the drill pointing through, and then crowds it, or if the machine springs, or if there is a drop of the spindle equal to the feed of a few revolutions, it means an excessive feed, and the drill is apt to find its way to the scrap pile instead of back to the toolroom.

Fig. 1 shows how we cure drills that are afflicted with *lapsus linguae*. The end of the shank is slotted the width of the tongue, down at an angle on each side, as indicated by the dotted lines, and a piece of tool steel is brazed in. If the shank is small compared with the diameter of the drill, the steel piece extends on either side of the shank, and the socket is slotted out so the drill can be put in, all as shown in the illustrations.

We are now up to the subject of sharpening drills, which operation should consist only of grinding the cutting edges, so each will do its share, at 59 degrees to the axis of the drill, and with a proper amount of clearance for a given feed and material. This is a comparatively easy job with the special grinders on the market for the purpose. And there have been a number of gages shown in the AMERICAN MACHINIST, by the aid of which I believe drills can be ground by hand in an A1 manner.

Fig. 4 shows a drill gage that has gone through several stages of development; it is new, I believe, in some important respects, and is well adapted to show if a drill is correctly sharpened. The drill shank is free in the socket, and rests on a center-pointed micrometer screw by which small endwise adjustments may be made. The other end of the gage body is slotted parallel with the axis of the socket. A blade with a tongue rigidly secured to it is free to slide endwise in the slot, when not clamped with a bolt and thumb nut. The blade is set at an angle of 59 degrees to the tongue, or at any other shop standard. The smaller blade is slotted and graduated, so it can be adjusted to the diameter of the drill to be ground, then clamped in that position, with a thumb screw, to the tongue in the slot. The angle blade is short enough to allow the drill to be removed from the socket by turning the drill so that the point of the blade follows the flute.

This gage is especially serviceable in sharpening twist or other drills, when ground as shown in Fig. 2. The object of this method is to give the cutting edges all the clearance the conditions (kind of metal, feed, etc.) require, and to prevent a tendency to gouge in when the drill points through the work, by the shoulder *c* striking the bottom of the hole; for the drill cannot be fed faster than the hight of this shoulder or heel will allow. So far as I am able to determine, about the best hight of the heel above the cutting edge of a two-lipped drill is one-half the feed, plus the amount the edges are permitted to wear off before regrinding.

If we assume that the arc from the cutting edge to the rear end of the shoulder is one-fourth the circumference of the hole, and that a two-lipped drill is ground as just described, its maximum feed is clearly double the difference between cutting edge and heel, when the edges are keen. As they wear off, the feed must decrease, and when the edge is worn up to the hight of the heel, the feed must be zero.

The difference in the hight of the cutting edge and heel is governed by the diameter of the drill, its feed, material to be drilled, etc. The only object of the heel is to keep the drill from being used unfairly, whether through carelessness of the workman, the voluntary feed of the drill or spring of the machine. Everybody knows that a sharp drill, other things being equal, cuts easier than a dull one, and as the heel allows most feed when the drill is sharp, it follows that the liability of the drill to break from a twisting force is about constant.

The arc *d*, to show the hollow grinding clearly, is exaggerated. Line *a b* represents the feed angle, and the distance *c* the amount the cutting edge of the drill may be worn off before regrinding is necessary.

Fig. 3 is a plan view of the way they are grinding their milling cutters at The Meriam-Abbott Company's place in Cleveland, O. The company could not get the grinder they wanted under six months. Under the circumstances, Mr. Meriam concluded to make a rig that would temporarily meet their requirements in that line. Accordingly he had some 2-inch plank clamped to one of the shop columns to form a table, which should support a small motor, and whatever else was necessary to complete the machine. While the table was being made, the motor shaft was fitted to carry an emery wheel, and the machine wired up. To form a guide for the cutter, a piece of polished shafting was forced into a crank disk, and then clamped to the table. A collar supported the cutter at the center of the wheel, and the job was complete. AMOS PRICE.

Cutting Rubber—Bending Tubes—A Wax Press—Combination Tap and Reamer—A Lathe Stop—Adjustable Angle Plate.

Editor American Machinist:

As I read the various letters in the AMERICAN MACHINIST I often think, "If

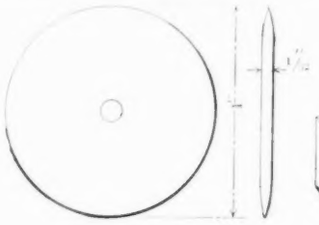


FIG. 1

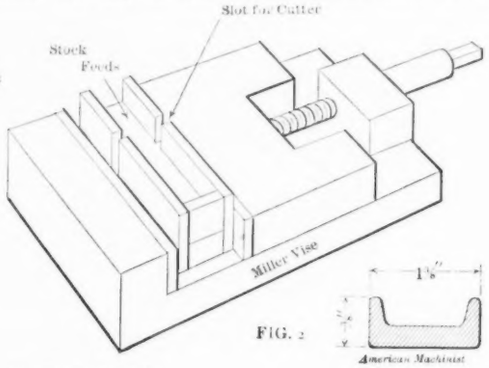


FIG. 2

CUTTING RUBBER.

I had only seen that letter before I did such and such a job, how differently I would have gone about it"; but sometimes I think the opposite and congratulate myself on what seems to me a better way than the correspondent's method. Something seen recently in your columns puts me in mind of a job that came into the shop where I was a "cub." The problem

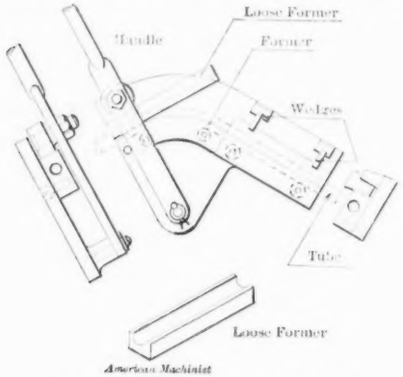


FIG. 3. RIG FOR BENDING TUBES.

was, to cut up a large quantity of rubber for use on bicycle pedals. The rubber (a huge boxful) came from the manufacturer in lengths of from 4 to 12 feet, just as it was "spewed" from the machine. We used a plain cutter in a hand miller. Fig. 1 shows the cutter; it was a disk of sheet steel finished to a sharp edge with a hand tool; it had no teeth and was not even hardened. It was run at the highest speed of a Pratt & Whitney hand miller. Fig. 2 shows the fixture, which was of wood and a crude affair. The stock was cut off as fast as it could be pushed in by hand, and the elasticity of the rubber was enough to jump it out of the fixture into a box. Fig. 2 shows also the section of the rubber.

Fig. 3 is another good fixture used in the same shop. It seems rather late in the day to come forward with tools for bicycle manufacture, but this rig is just as good for bending bedstead tubing and boiler tubes as it was for bending bicycle frames. The sketch is quite clear. The tube was wedged in position with clamps that exactly fitted the straight part, and the loose former was introduced between the roll and the tube, the bending, of course, being done by pulling the handle around. In the figure the tube is shown with the bending operation completed. The essential feature is to have the formers smooth and to completely envelope the tube. I have since seen some very pretty tube bending for Thornycroft boilers, but have never seen anything that beats the product of this machine. Both the above schemes are the work of Mr. E. E. Holton, of Springfield, Mass.

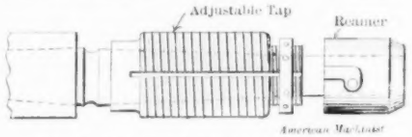


FIG. 5. TAP WITH RELEASING REAMER.

Speaking of "spewing" reminds me of a cheap tool for putting beeswax in a convenient form for patternmakers' use. Fig. 4 shows the tool. The body of the "machine" consists of a short piece of 1-inch gas pipe, reamed fairly smooth and threaded at both ends. One end of this pipe has a cap screwed on, two holes being drilled in the cap for the wax to be pushed through. The other end has a coupling made on, into which is screwed a plug with a straight hole tapped through it. This plug carries a screw, having a plunger on one end and a square head for a wrench on the other end. To use, clamp the tool in a vise, remove the plug, put in the wax (which has been cut up into small chunks), screw in the plug, then screw down with the plunger. Two nice streams of wax will be the result. These may be put away in the tool box for future use. The holes may be of different sizes to make two sizes of wax. Different ways of using it will readily suggest themselves to different patternmakers.

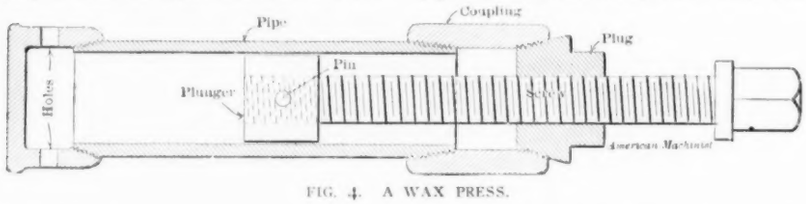


FIG. 4. A WAX PRESS.

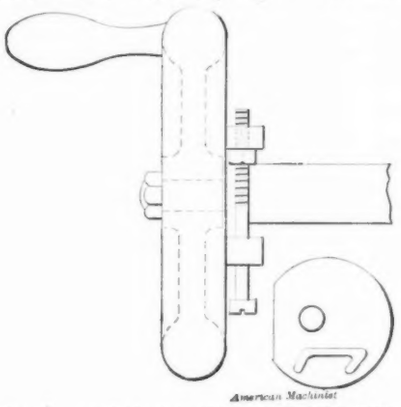


FIG. 6. ADJUSTABLE STOP FOR LATHE FEED.

Fig. 5 shows a combination tap and reamer for use in a screw machine. The tap may be adjustable by any system, the feature of the tool being the reamer. The reamer is loose on the tap, being held by the lock pin. As the tool goes in the hole is reamed and tapped at one operation, but instead of backing the reamer out through the finished thread, the reversing of the tap throws the reamer off and leaves it in the hole to be removed when the work is taken out of the chuck.

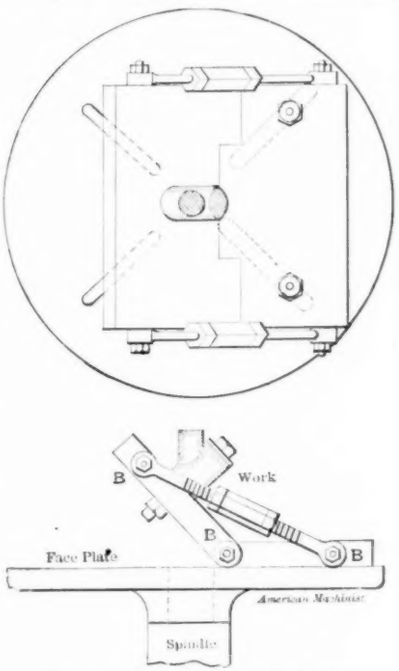


FIG. 7. ADJUSTABLE ANGLE-PLATE.

Fig. 6 is a simple lathe stop used on duplicate work. The cross-feed handwheel carries an adjustable screw which

strikes against the disk *A* when it is revolved into position. In using the lathe, the operator screws the tool up to within one revolution, then swings the disk into position by means of the wire handle. This stop is positive, if nothing else.

Where one has very much boring to be done at an angle, an adjustable angle-iron is a very handy tool. Fig. 7 shows such a tool. It is adjusted by means of right- and left-hand screws and locked by check-nuts. The screw connections at *B B* are studs put in to the fixture, with nuts outside to be screwed up to assist in making the fixture rigid after the correct angle has been secured. I have indicated in the figure a piece of work on the angle-iron, ready for boring. R. P. KING.

A Simple Device for Shaping an Emery Wheel.

Editor American Machinist:

It is often necessary, in grinding, to use an emery wheel having a true concave or convex edge or periphery.

A few years ago I was employed by a firm that manufactured bicycle chains in large quantities, the heads of the rivets being "spun" on by a pair of small rollers *A*, Fig. 1. When two of the rollers were placed side by side, as at *B*, the corners combined to make as perfect a semi-circle as possible. When through use the rollers became worn or "pitted" they were reground, and were thus used over several times. For the sake of economy and ease of adjustment, two or three dozen rolls or "spinners" would be ground at one time and accurately enough so the face of one roller would mate perfectly with the face of any other in the same lot.

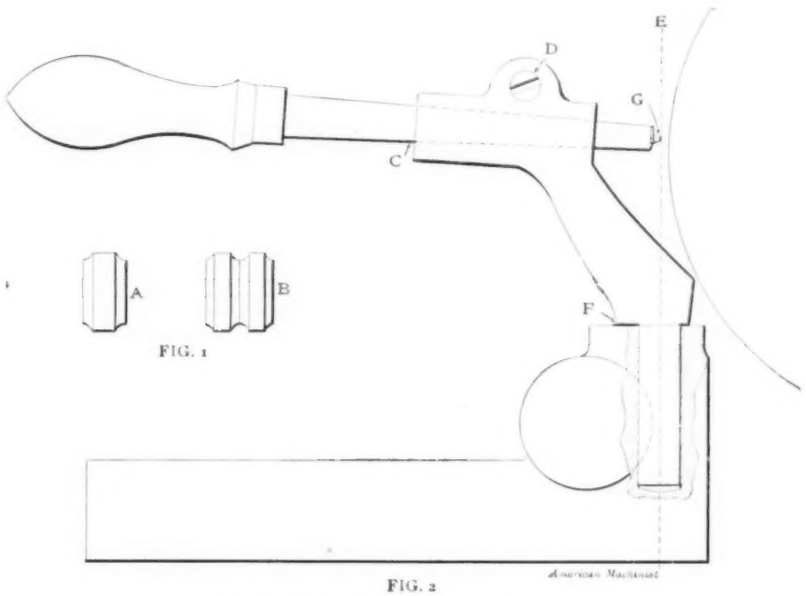


FIG. 1

FIG. 2

DEVICE FOR SHAPING EMERY WHEEL.

A forging was made and drilled through at *C*, Fig. 2, a binding screw being added at *D*, which held and clamped the diamond turning tool at any distance from the center line *E*; the lower end of the forging was turned with a shoulder at *F*, and made a neat working fit when inserted in one of the tooth rest holders supplied with the grinding machine.

If a roller for forming a rivet head with a radius of, say, ⅛ inch was required, the diamond truing tool was clamped in position with the point *G* one-eighth inch back of the center line *E*; the tool was then fed against the wheel by the cross feed, and the handle *H* swung slowly round by hand, turning the edge of the emery wheel to the desired radius.

With this tool-holder we could produce a wheel with any radius from 0 to 1 inch, which was very handy when grinding out the flutes of taps, "touching up" milling cutters, forming tools and other odd jobs.

By setting the diamond "by" the center line, a wheel with a concave edge was produced. MILLARD.

Cheap Gages for Rough Usage.

Editor American Machinist:

The accompanying sketches show how a set of simple gages was made to satisfy the requirements of a firm which was manufacturing a large quantity of small articles. The ordinary gage in the hands of a rough lad soon became worthless, owing to careless use, and of course was quite impossible to repair.

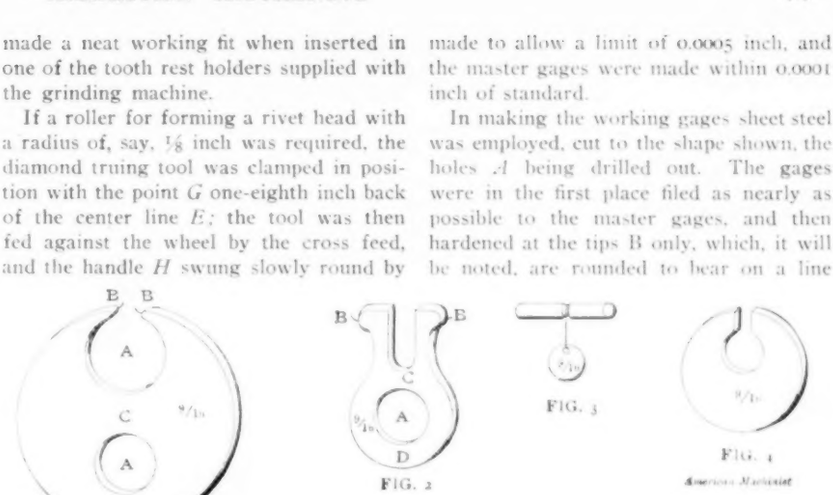


FIG. 1 FIG. 2 FIG. 3 FIG. 4

GAGES.

Figs. 1 and 2 show the working gages, and Figs. 3 and 4 the master gages as used in correcting them. A pair of each was made to allow a limit of 0.0005 inch, and the master gages were made within 0.0001 inch of standard.

In making the working gages sheet steel was employed, cut to the shape shown, the holes *A* being drilled out. The gages were in the first place filed as nearly as possible to the master gages, and then hardened at the tips B only, which, it will be noted, are rounded to bear on a line only. They were adjusted either outwardly or inwardly, as the case might be, by peening at the points *C* and *D*, respectively, until the master gage showed them to be correct. To avoid bending, they were peened alternately on each side. They were periodically examined and, if need be, corrected by the toolmaker. GAGES.

Truing Rubber Rolls.

Editor American Machinist:

Having noticed from time to time in your column of "Letters from Practical Men" an occasional note on the cutting or turning of rubber, soft and otherwise, and having seen nothing exactly in line with my own experience, I thought I would try to show my appreciation of the letters of Messrs. Osborne, Tecumseh Swift, Danse and all of the other ingenious fellows who interest and amuse us week after week, by writing a few notes of my experience on this subject, which seems either too well known or too little known to attract much attention.

Having been connected for a number of years with textile finishing plants, it has fallen to my lot to turn up, or rather true up, large numbers of rubber-covered rolls of sizes ranging from 8 to 18 inches in diameter and from 18 to 96 inches long.

These rolls perform much the same duties as the ordinary cloth-wringer rolls, except that in squeezing out the surplus dye stuff or other chemicals, it must be done very evenly, so as not to alter the shade of the finished goods. Most rolls of this kind are made by cementing laps of rubber, about ¼ inch thick, on a cast-iron shell, roughened by threading, the laps just long enough to make a butt joint. This lapping is continued, breaking joints, until the required thickness, of from 1 to 1½ inches, is obtained.

The rubber composition used is made of varying degrees of hardness to suit the work and the temperature of the liquid. The medium hard compositions work very nicely with a diamond-point tool, ground a little round on the point and given a

sharp rake. The tool should be hardened very hard, as there is sufficient fine grit in the rubber to wear the edge badly. The speed is governed by the ability of the tool to stand up to the work, and is slower in proportion, as the rubber is harder.

The soft rolls cannot be cut satisfactorily with any kind of a tool I ever tried, and the best and quickest way is to grind them down. In fact grinding makes the most satisfactory job, whether the rubber is hard or soft.

The grinding may be done in a lathe, using an overhead drum for driving the wheel and bolting the wheel arbor to the tool-post block.

In plants where electricity can be had a small direct-connected motor, with flexible cord and plug, makes the most convenient drive, as it is readily detached and put away when not in use, leaving plenty of head room over the machine, a quite important detail in shops where most of this work is done, and where one or two lathes have to do all the work, large and small.

The best results are obtained by using

FIG. 1. A SAMPLE CIRCULAR CASTING.

cast-iron disks for wheels, 8 to 10 inches in diameter and 1¼ inches thick, with a groove 1 inch wide and ⅛ inch deep turned in the face. This groove is filled with strong twine, laid on tight in hot glue and then covered with several coats of glue and No. 40 emery. These wheels are to run dry. A fair job may be done by running across the face of the roll with No. 2 sandpaper, wrapped on a block and held to its work by the tool-post, although this method is slow and not very accurate.

L. L. ARNOLD.

Circular Pattern Work.

Editor American Machinist:

Many different shapes and sizes of circular patterns may with advantage be prepared for the molder's use by the method about to be described. This method is of equal value as a time-saver whether 6 or 1,000 castings are wanted from the pattern made. It has also the advantage of providing directly for the molders' use a pattern equal in every respect to a plate pattern and which may in many instances be worked by comparatively unskilled labor. Fig. 1 is a plan and section of a

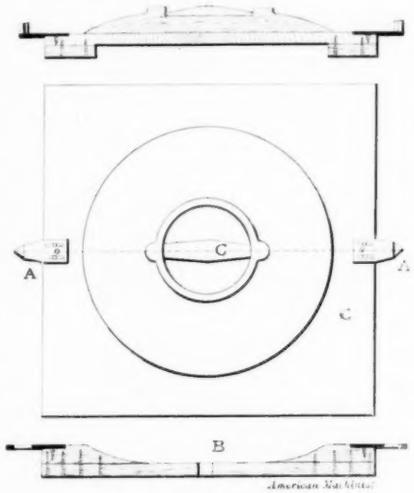


FIG. 2 PLAN AND SECTIONS OF PATTERN.

casting of which 1,000 were wanted. Fig. 2 shows section and plan of the drag part of the pattern, which is prepared by first truing up a suitable board and chucking the same in the lathe. The convex side of the pattern is fastened on to the board and turned down so that the board serves as a joint when used in the molding shop.

The pattern used to form the concave side or top part of the mold is prepared similarly to the drag, with the exception that the board is made sufficiently thick to allow the contour of the pattern to be turned out of its face. At *B* is shown in section the top part of the pattern. *C* is the drag part of the pattern complete. The pin guides *A A* are set on the center line and at equal distances from the center of the pattern board. These guides fit corresponding pieces on the snap flask used to make these molds, and similar guides are fitted to the top part of the pattern board. To make a mold, the two pattern

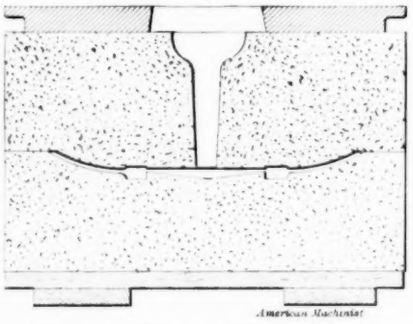


FIG. 3. SECTION OF MOLD COMPLETE.

boards are placed side by side and both drag and cope are rammed up together. The drag is turned over, the pattern rapped off, and the top part is lifted off the pattern and placed on the drag. The flask is next taken off the mold and the weight is placed on the top. This leaves the mold, as in Fig. 3, ready for pouring.

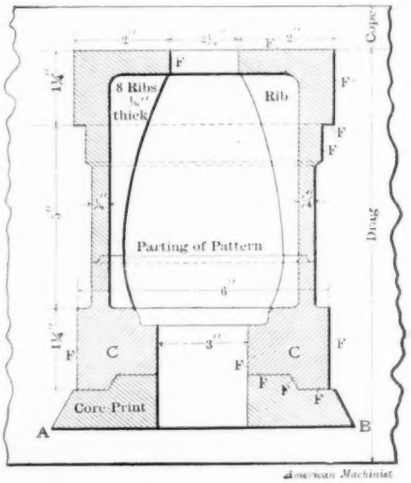
G. BUCHANAN.

A Pattern Making its Own Core.

Editor American Machinist:

The sketch herewith is for a brass casting for which a pattern was made. The way in which the pattern was made and the molding may interest some of your readers, as it did me. To some it may be an "old joke." I wish you would publish a few of these "old jokes," and I don't think it would harm some patternmakers if they would buy or borrow your valuable paper and read of them.

Four castings were wanted in a rush. The molder boss was consulted and he said, "If you make the pattern for a two-part flask I will have them for you this afternoon." He instructed me to make the pattern as here shown, with parting and core prints and core-box. I did so and got my castings true to pattern and on time. The pattern was placed on a board, cope side down and the drag was filled with sand and rammed up to line



A PATTERN MAKING ITS OWN CORE.

A B. Next *C* (part of pattern and print) was lifted out of the sand, and in place of the core print a dry sand core was placed, after which the drag was filled, struck off and rolled over. The cope was placed on, rammed up, lifted off, the pattern was drawn and the cope then replaced.

I wish to mention an incident which took place in a pattern shop when I was a cub. At that time I knew—or thought I knew—more than all other patternmakers, and so did one of the other fellows working in the shop. Every article in a mechanical paper to him was "dam foolishness." A pattern on this order was given to him to make, and to be molded in a two-part flask. Well, he made it, but he parted it lengthwise and made the center with a core. Often this fellow would call me and say: "Say, kid, anything I don't know about this business ain't worth knowing: I am just full of patternmaking."

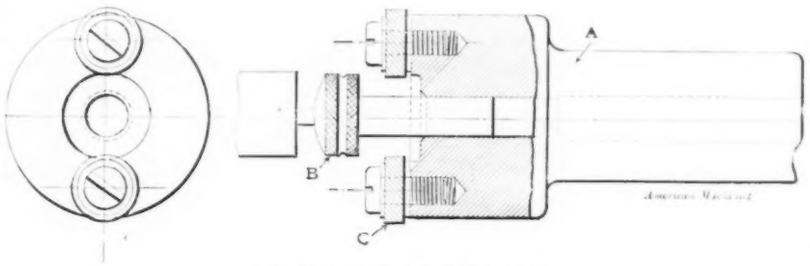
BRASS CASTING.

A Knurling Tool for The Turret.

Editor American Machinist:

The sketch shows a knurling tool which strikes me as being novel, but possibly it has been used before. Holder *A* is made of machinery steel; it is turned to fit the turret, and bored to a nice sliding fit for the shank of the sample plug *B*. This acts as a steady while knurling the head. It is recessed at the front to clear the head, and deep enough to allow of the knurls clearing when fed over the work. The bottom of this recess also acts as a stop against the face of the head. The knurls *C* are made a nice running fit on the two screws, which are screwed tight into the holder.

W. T. PARKES.



KNURLING TOOL FOR THE TURRET.

A Broaching Job

Editor American Machinist:

Broaching is very interesting work. Some mechanics think the best and only way to make a broach is in one piece; I don't think so—long experience has taught me that it is the wrong way. To do the job shown in the sketch with one broach would require a long one—and that would cause trouble; for a broach of sufficient length for this work is difficult to turn and mill, and to harden and draw, owing to the keyway on one side which will cause it to spring in hardening; it would be an advantage if it were grooved on opposite sides.

The hole in the piece shown in Fig. 2 is broached from ½ to 41-64 inch—and a key 1-16 inch high formed—and is afterward drifted, as in Fig. 3, to 11-16 inch at the bottom and ¾ inch at the top; the thickness of the piece is ¾ inch. Over 250,000 pieces have been made with the broaches as shown, and the loss in broaches and pieces was nothing compared with the loss when using the long broaches first made.

The stock for this job is a special, tough tool steel. The broaches are shown in Fig. 1; they are 4 inches long and of the diameter given. Each is tapered at one end and countersunk at the other, and the top or male end is milled flat on one side (like No. 4) to fit the punch press fixture, Fig. 5. Nos. 1, 2 and 3 have five teeth per inch, and No. 4 has six teeth; you will also notice the latter broach is left blank at one end; this I will explain later.

The teeth begin ⅜ inch from the end; this part is drawn to a blue after hardening. This is very important, as the end has a tendency to crumble and break out and thus destroy the broach. The end is drawn by dipping in hot lead after the broach is hardened and drawn to a straw color. For cutting tool steel a very little clearance is given the teeth; too much clearance will cause the broach to cut ragged.

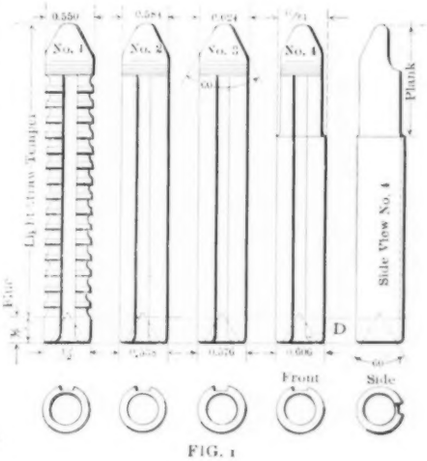


FIG. 1

After Broaching
FIG. 2

After Drifting
FIG. 3

FIG. 4

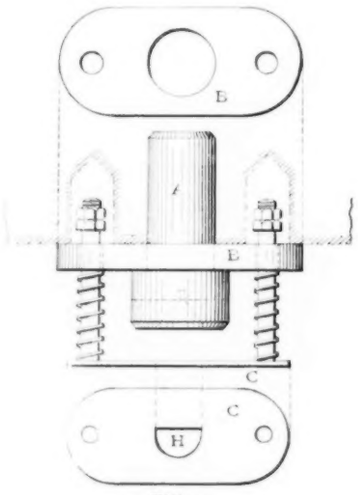


FIG. 5

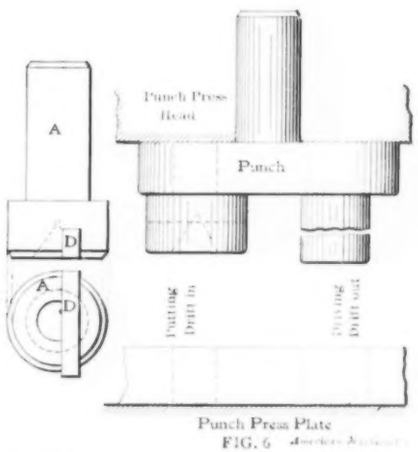


FIG. 6

BROACHING TOOLS.

The ½-inch hole to receive the end of the first broach is drilled in the stock, and the other end of the broach is inserted in hole *H* in plate *C*, Fig. 5. To the plate is secured two rods which have a vertical movement in plate *B*, light springs keeping plate *C* away from the punch. An important feature is the hole *H*, which receives the end of the broach and prevents its being placed in the wrong position, as each broach must follow exact, owing to the keyway.

A clearance (shown at *D*, Fig. 1) on each broach guides the end of the broach while entering. After the first broach is entered and forced into the work by the press, the upper end projects above the work to receive the second broach, which is in turn punched through, being followed by broach No. 3 and the latter by No. 4. If teeth were cut the full length of the last broach, it would stick in the work; to overcome this it is cleared at the end, as shown, so that when punched down to the end of the stroke the broach will fall through. The work in making broaches of this length is simple, as they are easy to turn, harden, draw and grind.

In punch *A* a hardened steel plate *D* is inserted, as at this point any wear may cause the broach to twist and spoil the key. This is made a driving fit and can be replaced at any time. The finished

hole, Fig. 3, is drifted cold; this, owing to the quality of the stock, is a neat piece of work. Figs. 4 and 6 show the drift and the punch press fixtures. The punch for putting in the drift has a steel insert the same as *D* in *A*. It is very important in making broaches that the stock be thoroughly annealed; and, when broaching, use nothing but the best oil. D. G.

A Tailstock Steady-Rest.

Editor American Machinist:

On some work between centers in the bench lathe, the steady-rest furnished by the makers comes in the way of the slide-rest, and having occasional use for something of the sort, I devised the steady-rest shown herewith, to be clamped on the tailstock. I do not know whether to call it original or not, as it is a combination, with modifications, of two ideas of other men. Mr. A. H. Cleaves, in his book, "Ways and Means," shows a steady-rest to be clamped on *tail spindle* of engine lathe, and Mr. C. O. Griffin, at page 1162, Vol. 19, shows a steady-rest for a grinder that is a blood relation to Fig. 2 herewith.

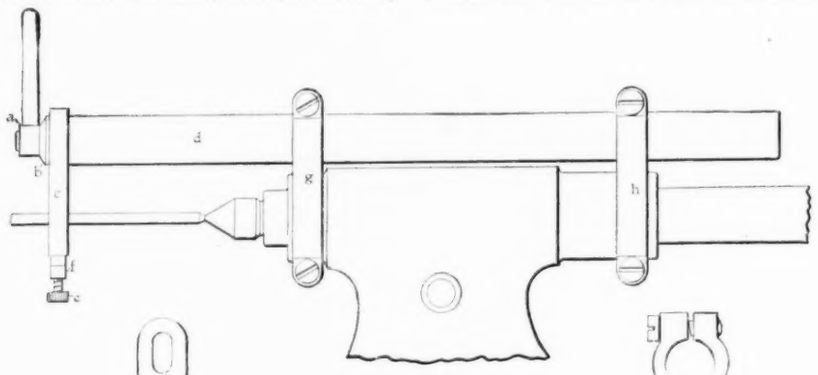


FIG. 1

FIG. 2

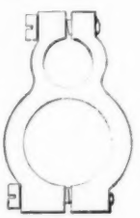


FIG. 3

A TAILSTOCK STEADY-REST.

The makers of my lathe turned each end of the tailstock casting exactly the same size outside, probably for manufacturing reasons, but these two places offered an excellent opportunity for clamping on two castings like Fig. 3. The upper hole in Fig. 3 takes a 5/8-inch round bar, either cold rolled shafting or drill rod, the outer end of which is turned down to 1/4 inch and threaded to take the nut *a*, which is made in one piece with a lever. The washer *b*, in connection with nut *a*, clamps the steel piece *c* to the round bar *d*. The piece *c* has an oblong hole where it is clamped to *d*, which admits of some up and down adjustment. The lower end of *c* has a 3/8-inch hole, which is filed to a V-notch on its upper side and hardened at this point. The fine threaded knurled screw *e* is hardened at its end, and locked by nut *f*, which is in one piece with a lever.

The method of setting is this: We will assume that we have a true spot on the work where the steady-rest is to bear. Assemble the parts as shown in Fig. 1, but with clamping screws in *g* and *h* loose. Clamp *g* and *h* to *d* first, and to tailstock casting afterwards, which will tend to prevent *d* from being skewed around. Of course, *d* need not be exactly above the tail spindle, but can with advantage be placed slightly towards the back of lathe, as then the V-notch in *c* will be in a better position to take the thrust of the cut. After *d* is clamped in place, the nut *a* can be loosened and *c* will drop by gravity on to the true spot of the work, after which *a* is tightened. Finally the screw *e* is tightened till it just touches the work, and then locked with nut *f*. The end of *e* has a comparatively small area in contact with the work, but it does not have to take the thrust of the cut. If *e* is screwed up with the fingers till it bears moderately tight against the work, when *f* is locked tightly it seems to strain *c* away from the work by just the minute difference between a tight fit and a running fit, so that part couldn't work better. If the work is too delicate to bear the weight of *c* before it is clamped to *d*, a piece of wire projecting slightly from a chuck can be turned to the size of the work where steady-rest is to bear, and *c* can be set by that. The bar in my steady-rest is 3/8-inch drill rod, but that is altogether too small. However, I think with a 5/8-inch bar, or larger, it would make a first-class rig, and I shall put a larger bar in mine some time when opportunity offers.

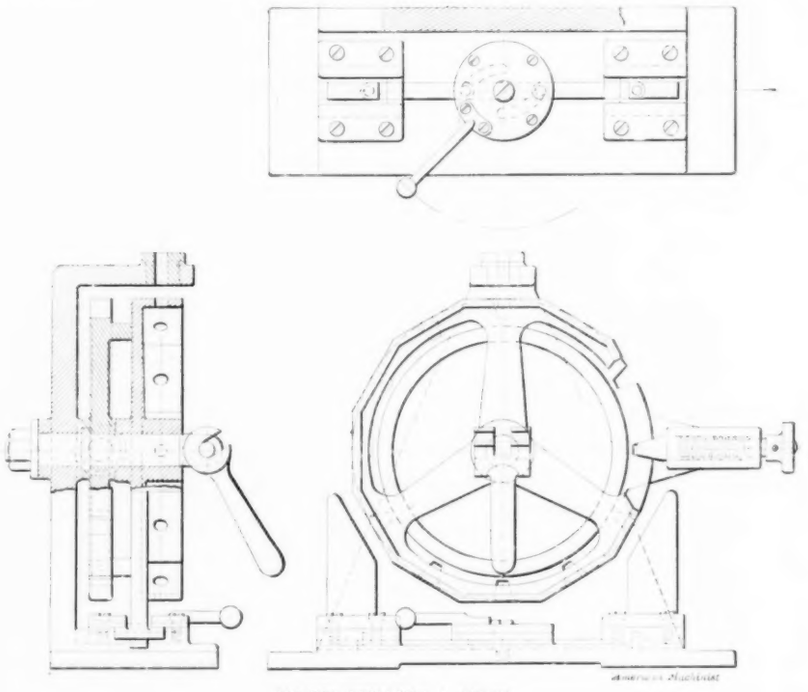
WALTER GRIBBEN.

Jig for Drilling a Spider.

Editor American Machinist:

The drawing shows a jig which I designed and which worked very well indeed, it being both quick and accurate in operation. Its work was to space, equally, twelve holes around a twelve-sided spider, two of which having wood lags bolted to their sides, formed the ends of a belt idler pulley. This spider was an unfinished casting, not even the hub being faced, giving no finished surface to locate it by, with the exception of the bore.

The operation was as follows: The spider was slipped upon the stud, which was a driving fit in the index wheel and a running fit in the jig frame. Then the handle of the cam (shown in the plan) was moved over, bringing the side clamps to bear on the spider and bringing the



JIG FOR DRILLING A SPIDER.

upper face central with the drill. Then the locking cam, of case-hardened steel, was hooked on to the stud and tightened against the end of the spider hub, clamping it firmly against the index wheel. Then opening the side clamp allowed the index plate and the spider to revolve when the spring pin was withdrawn.

This locking cam is the point I wish to call attention to. It works so quickly, requiring a mere turn of the wrist to lock or unlock it, and when unlocked it is ready to fall off out of the way, leaving the work free to come off the stud. And it holds very firmly; I tightened it with a moderate amount of force and found I could not move it by pulling on the spider arm. I think it can be relied upon to hold anything firmly enough for drilling or for light milling cuts. R. C.

Steam Bending Under Difficulties.

Editor American Machinist:

Repair men in mills sometimes have jobs to do that are just as unsuited to the means at hand as anything Mr. Osborne has told us about. The accompanying sketches are intended to show how I bent the wooden shoes for a friction clutch, without any special tools. The clutch in question was a 40-inch clutch coupling, the shoes being, as I recollect them, about ⅞ inch thick, 4 inches wide and 10 inches long.

FIG. 3. BENDING THE STRIPS.

We had plenty of 4-inch maple plank on hand, and sawed four ⅞-inch strips out of it, the strips being about 8 feet long. This was enough to make all the shoes we wanted and have some left over. After sawing, the strips were smoothed with a plane, to lessen the work of fitting. Some old strips of sheet brass of about No. 30 B. W. G. and of the proper width, which we happened to have on hand, were cut into lengths, the ends annealed, and then turned over the ends of the wooden strips and secured by screws, as shown in Fig. 1. The object of the brass strips was to prevent very much stretching of the fibers on the outside of the stick.

One of the steam boilers at the plant being out of commission, I determined to use it as a steaming box. It was a horizontal fire-tube boiler of the ordinary type, with a manhole at the front end to serve as a door. I put a couple of short sticks crossways of the boiler and laid the maple strips on them, shut the manhole and filled the boiler with steam. While the wood was steaming, we rolled an old 40-inch pulley out of the cellar, laid it on the ground outside the boiler-room and drove a couple of stakes between the arms to keep it from turning.

I next called on the blacksmith and got him to make a few clamps of ¾-inch round iron, like the one sketched in Fig. 2.

FIG. 1

FIG. 2

THE STRIPS OF WOOD AND THE CLAMPS.

After three or four hours we judged that the wood was sufficiently soft, and, shutting off the steam, we knocked out the manhole plate and fished a strip of wood out with a pair of long-handled tongs.

The strip was placed in position, a clamp driven on, a big wrench put on the other end, and the strip was slowly bent around the pulley. A second man followed the wood up with a hammer, rapping it into place and driving on clamps where necessary. Fig. 3 shows the operation of bending. When one strip was secured, the pulley was turned over and the operation repeated on the other side. A second 40-inch pulley was used for a former for the other two strips.

The wood was dried by putting the strips (pulleys and all) on top of a boiler. After a few days' drying, the clamps were knocked off, the brass bands removed and the best portions of the bent wood sawed to approximate length and put away for use as shoes for the clutch.

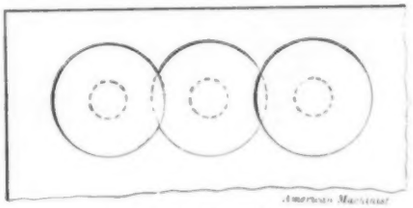
R. P. KING.

A Couple of Drilling Kinks.

Editor American Machinist:

When drilling large holes I often omit the gaging by first drilling a small hole—say, ⅛ inch—to the depth to which the point of the large drill is to go. This small hole is not liable to run out, and acts as a leader.

When drilling holes for a slot in a shaft or for cutting out plates of irregular form, I first drill all the holes through with a smaller drill, and when enlarging those holes first take every other hole, which will leave the same amount of stock on both sides of the remaining small holes, and which will allow the crowding together of the holes as in the sketch, without the danger of the drill running into one of the neighboring holes.



A DRILLING KINK.

J. SCHURING.

[In some shops this plan is, and long has been, well known; in others it is entirely unknown, and it is well worth knowing and practicing everywhere.—Ed.]

Comments on Recent Patternmaking and Foundry Articles

Editor American Machinist:

Comment would seem presumptuous on Mr. Vickers's splendid article on casting commutator segments at page 328, but the splitting of those patterns and placing them on both sides of the card plate seem to me entirely unnecessary in this instance, as it not only doubles the cost of the metal patternmaking, but actually complicates the molding, by making the cope lift a delicate operation, when by having all the patterns and sprues on the drag side of the card, and the gate runner only on the cope side, the cope can then be yanked off in any old way, thus facilitating matters greatly. Let me suggest that in place of using a cast-iron plate ⅜ inch thick, planed on both sides, as a card, that he use a rolled brass plate 3-16 or ¼ inch thick, as it is vastly superior to iron and cheaper in the long run. For flask boards, either bottom or top, Mr. Vickers will find upon trial that a thin cast-iron plate, say, ¼ inch thick, and perforated with holes ⅜ inch diameter and as close together as will cast, with ribs on one side ½ inch high all around the edges, will "bed" firm with less rubbing than other boards usually will.

Mr. Newton's letter on "Making a Pattern for a Cylinder Bushing," at page 338, is decidedly interesting as a work of art produced by a "latheless" patternmaker in the "hop district" of New York. Mr. Newton affirms that this bushing is most fearfully and wonderfully constructed of 144 segments 1½ inches thick, which necessitated the use of 2-inch stock, thus wasting at least 22 feet of pattern lumber, which, from the latest procurable quotations on stock of same thickness, costs delivered in carload lots $70 per 1,000 feet anywhere in New York State, hence the figures show that $2.73 worth of stock

was added to the scrap pile at 144 fell swoops or so. In addition to the waste of valuable stock, he has on his pattern twenty-three glue joints outside 74.6 inches long *each*, and the same number inside, 63.6 inches long *each* directly across, and 144 butt joints in line with, the "draw." Now, Mr. Newton must know that this is not the most practical or, by long odds, the cheapest and best way of making such patterns, even when handicapped by the absence of a lathe. Why a lathe should be used in this case is something beyond my comprehension, as any man who follows the rules laid down by the Marquis of Queensberry would unhesitatingly build this pattern of lags on false heads, and make it quicker and better than ever segments could be shaped to, with the added advantage of having all glue joints—which in this instance need not exceed eighteen—entirely in line with the "draw." A somewhat long and varied experience has proved to me that the "life" of lagged patterns of this type exceeds the segmental breed by some moons.

At page 344 "Patternmaker's" letter on "Draft in Gear Patterns" of the "Herringbone" species is instructive, in that it brings to light the usual diversity of opinion existing between patternmaker and molder, a condition that has prevailed since the "cliff dwellers" made patterns for and cast their first door-knockers, which accounts for the "knocking" tactics employed by these artisans up to date. "Patternmaker" was right when he made his pattern to mold in a two-part flask, and may he live long and prosper for the following reasons: The one great objection to molding the teeth of such gears in a cheek, is that the ramming due to the angle of the teeth, right and left, tends to force the two half patterns apart—in fact, so much so that I have seen discarded castings with a well-defined groove at the center of the teeth, say, half the depth of the same, the iron having washed away the rest. Of course the molder will sometimes try to *improve* matters by attempting to "slick off" the teeth at the center with marvelous results, as anyone can testify to who has had any experience on this class of work, though in the case quoted above the molders had evidently forgotten or didn't care. An extra "roll over" is necessary when a cheek is used, and this means an extra hand or two if the wheel is big, and when we count the extra time and extra flask and the extra chance of a bad casting, it does seem that the two-part-flask method is the best in ordinary cases, all things considered. Sometimes, for rolling-mill use, the pinion of this type of gear is shrouded; in this event it certainly is necessary to use a cheek, and, to provide against the ill-effects of ramming, the halves of the pattern are screwed together from the cope side, the screws to be taken out after the cope is removed.

Mr. Shaw contributes a letter, at page 345, on "Molding Short Flanged Pipes," that is first-class, and he will pardon me, I know, while I attempt to describe how we make connecting-rod bushings that are similar in many respects to the pieces sketched by him. We use no jointing plate, but have the drags rammed up by a helper a dozen or so at a time cheaply and quickly on a molding machine, both sides strickled off flush and a board placed at bottom. The molder in turn, after scooping out a cup-shaped space about equal to the inside diameter, places the pattern on the same, rams up the core as part of the drag, forcing three spikes clean through almost to the bottom board. After sprinkling his parting sand, he rams up the cheek and in turn the cope, and, after lifting off the same, he lifts out the body of the pattern, then the cheek and finally the loose ring and, after closing, it is ready to pour in less time than the method described by Mr. Shaw would take, I think.

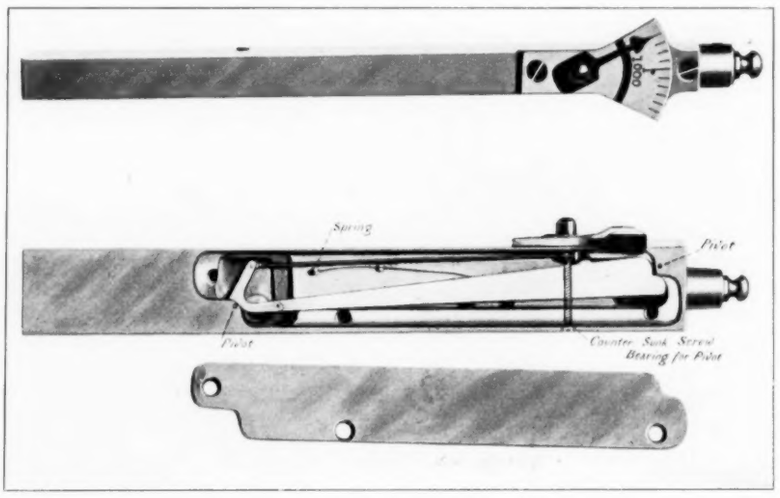
Mr. Buchanan's letter on "Molding an Air Pump Casing," at page 354, shows that material and time are not important enough factors to be considered, at least not in Wrexham, North Wales, as ye ancient method of making this job in loam, as shown by his sketches, certainly proves. Any foreman molder who couldn't make this casting in green sand with a couple of "draw up" rings, a templet or two and flanged branch and ribs as loose pieces ought to be spanked. *Loam work is not cheap.* This may surprise some of the learned M. E.'s, who pose as molding experts and who are largely responsible for a lot of castings being made in this way, from a misguided conception that by saving pattern work they save money. Now, this is not always so, even where but one casting is wanted. Loam molders are paid as well as, if not better than, patternmakers, and loam molding is necessarily slow and not always sure work, there being, in the main, just as many chances for bad castings as when green-sand molding with a pattern is used, even though it be only a skeleton. The old days, when crane facilities for lifting green-sand molds were limited, have gone "where the woodbine twineth," and nowadays they hesitate at nothing in the lifting line, as is evidenced by the Westinghouse people casting their colossal engine A-frames in green sand, a feat that is enough to prompt all loam molders to seek the tall timber. In one of the biggest manufacturing foundries in this country, which also does a lot of outside work, they are quite willing to make loam castings for *outsiders* at a good, stiff price, but I've noticed that all their own stuff that could be cast in loam is made in green and dry sand from patterns. Upon twitting the foreman on this state of affairs he imparted this secret: that as long as those in authority in the different establishments that sent them work were satisfied to pay as high as 8 cents a pound for loam castings, *his* people certainly were.

OLD BOB.

Test Indicator.

Editor American Machinist:

As we toolmakers are always interested in seeing something new, especially if it is a good tool to add to the collection in the tool chest, I thought I would "let her go," as the rest have been doing.



TEST INDICATOR.

The photograph shows a test indicator which is just all right. As is plainly seen, it will go where any lathe, shaper or planer tool will go, or it can be used in a milling machine, as the whole mechanism is arranged within the stock.

I find it sensitive to 1-20000 part of an inch on smooth work revolving in the lathe. This seems rather fine, but this error can be easily detected by closely observing the pointer, any day in the week—except Monday and Saturday.

As will be noticed, the lever system is arranged sidewise, so as not to weaken the section where the tool-post screw clamps. The body is made of a piece of cold-rolled steel, with one end turned down as shown. The push-pin is of tool steel and presses against the main lever.

which is made of spring steel and pivoted ⅛ inch from the point where the push-pin strikes.

The long arm of the spring steel lever acts upon an arm which is connected by a rod to a sort of crank upon which, and above the dial, is fastened the pointer. The levers are fulcrumed on double-pointed pins, one end fitting into a countersunk hole in the body of the tool and the other fitting a similar hole in the end of a screw, so that lost motion may be taken up.

The photograph shows the thin sheet-steel cover removed. The range of the instrument is 0.010 inch. G. D.

Sawing a Crooked Slot—An Irregular Ratchet Feed.

Editor American Machinist:

If one were asked to do the job depicted by Fig. 1, how would he proceed to its accomplishment? Possibly mark it out and drill a row of holes as close together as possible, afterwards removing the intermediate bits of metal by chisel and file. Time? Well, not far short of a couple of hours to make a decent job. But the tool shown in Fig. 2 makes that slot in less than a minute and at one blow, and a girl operates the machine. The only particulars I was given were of the saw, so that how the work was fixed or the saw driven I can but guess. If the work were fixed on a jig, forming also guides to prevent the saw swerving from its proper course, the saw could be pulled downward if held in a suitable frame by the back edge. The blank is shown fixed ready for starting at *A*, Fig. 2

The idea is no doubt borrowed from the dovetailing machine saw shown in Fig. 3, which is a similarly crooked affair, and either of them presents to our notice a rather smart way of getting out of a difficulty. Cutting round a corner at first thought appears to be quite as difficult as seeing round a corner appears to those who don't know how it's done. Our admiration is excited by the simplicity of the solution.

Some peculiar ratchet wheels were made here lately. Fig. 4 shows one of these. It will be noticed that one tooth is half as long again as all the rest. If the actuating pawl were given sufficient throw for taking the longest tooth, the result would be twenty-two movements of $\frac{1}{23\frac{1}{2}}$ of a circle, followed by one movement through $\frac{1\frac{1}{2}}{23\frac{1}{2}}$ of a circle. If, however, the pawl were regulated to take only the shorter distances, then the ratchet would cease rotating when it reached the position shown in the sketch.

Perhaps this would be useful as a safety device. What the wheels were actually to be used for, I do not know; but several different numbers of teeth were cut, as $21\frac{1}{2}$, $22\frac{1}{2}$, and so on.

FRANCIS W. SHAW.

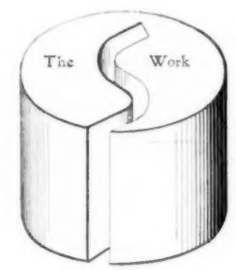


FIG. 1

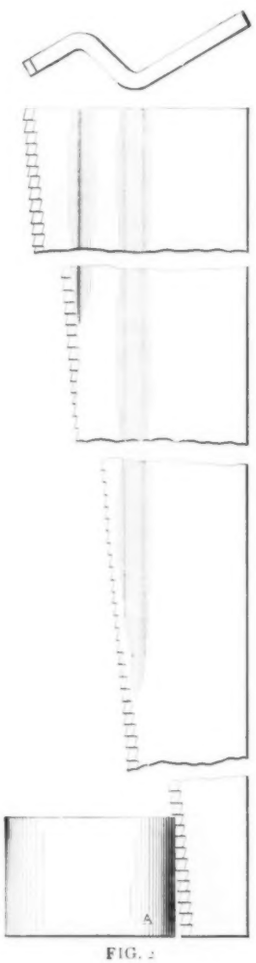


FIG. 2

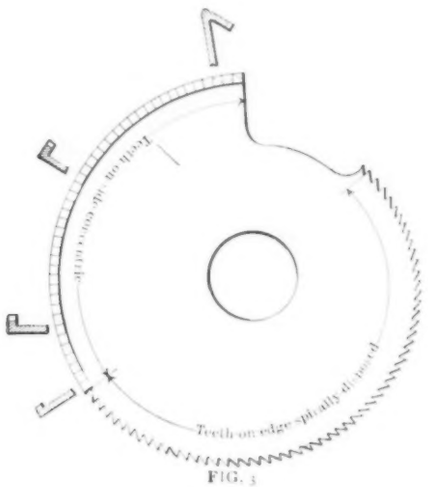


FIG. 3

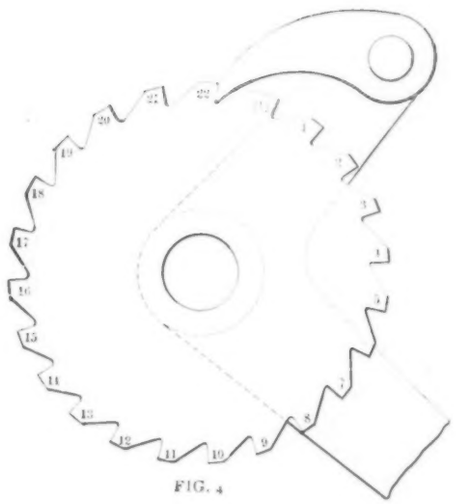


FIG. 4

TWO PECULIAR SAWS—IRREGULAR RATCHET FEED.

A Soldering Flux.

Editor American Machinist:

I send herewith a formula for making a soldering flux, which I received from a fellow workman, and have found it to be a great help in soft soldering or tinning iron and steel.

The flux consists of 2 parts zinc chloride, 3 parts glycerine, 5 parts alcohol.

I have used both the granulated zinc chloride, that comes in small vials, and also that made by dissolving zinc in hydrochloric acid, but prefer the former.

In using the flux it is very essential that the surfaces to be tinned or soldered should be perfectly bright and clean, and it is possible to solder even cast iron, if due care is used. It is generally the best policy to heat the parts to be soldered, directly in the gas or other flame, and to be sure and apply plenty of the flux, especially just before applying the solder.

C. D. KING.

Six-Spindle Drill Jig.

Editor American Machinist:

A very rapid jig for chucking and drilling small links is shown in the sketches; particular attention is called to the slide *D* and the clamps *F*, which I will explain later.

At *A* is shown the table of the six-spindle drill; *B* is the main frame and guide to receive carriage *C*, and *D* is a carriage sliding in *C*. The steel chucks *E* are secured to *D* by screws, and the work

is held by clamps *F* operated by eccentrics *G*. Plates *H* are holders for drill bushings *I*. *J* is a strap to which the chain at the back is made fast and *K* a sprocket acting with the chain to move carriage *D*. *L* (Fig. 1 only) is a stop gage for carriage *C*. The cover *M* keeps the sliding parts free from chips. *N* is a lever for operating carriage *C*, while *O* is a crank for moving —through the sprocket and chain—the slide *D*.

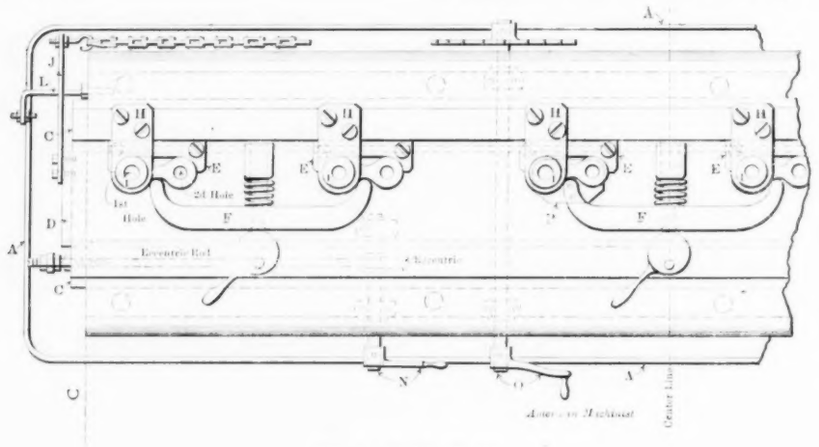


FIG. 1. PLAN OF JIG.

This jig may look a bit complicated to the reader, but if he could see it throwing out the work it would not appear so much so; for, understand, the jig is turning out 2,500 to 3,000 pieces each day, drilling through ⅜-inch machine steel, and two holes in each piece.

The distance from *C C* (Fig. 1) to the center line of the fixture is one-half the length of carriage *C*; this carriage is operated, as mentioned above, by the lever *N*, the latter being attached to a shaft which carries an eccentric from which runs a rod connecting with an adjusting stud at the end of *C*, as shown. Slide *D* is double the length of *C*, or long enough

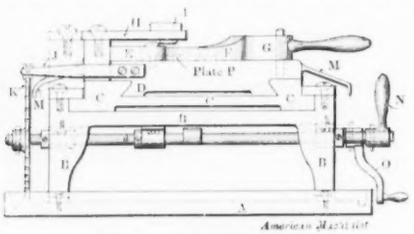


FIG. 2. END VIEW OF JIG.

to provide for two sets, or six clamps *F*, so that while six holes are being drilled the operator is putting six blanks into the jig. The table is raised and lowered automatically. After drilling the first hole in each of the six pieces, the table drops quickly and the eccentric is thrown over by the lever *N* until the end of carriage *C* strikes stop *L*, the carriage then being locked by an eccentric.

While only one drill bush is shown for each link, two are required for this job. The movement of *C* to the left brings each of the six links with the drill bushes into position for the second hole to be drilled. To drill the six other pieces the carriage *D* is then moved across by means of lever *O* until it reaches a stop (not shown), the work then being drilled in the same manner as the first six links. A sheet-steel plate *P* is riveted to each end of clamp *F* and on this the work is placed before clamping. This makes the work of feeding easy, as the plates carry the blanks to the holders *E*. Directly under each piece being drilled a hole is cut through *D*, this being large enough to permit the piece to drop through; when clamps *F* are released the pieces are blown through the openings into a receiver below, as are also all dirt and chips. The clamps *F* are released by means of springs when the eccentrics are turned. A single drill bushing *I* can be used by carrying the back of frame *B* up and bolting plate *H* to it, as shown by the dotted lines; this construction makes *H* stationary.

X. Y.

Making a Jig.

Editor American Machinist:

I was given the job to make the jig shown at Fig. 1. The first thing was to machine the top, bottom and back of the casting. This was to fit another part made to receive the work. The part we here have to do with was held to that already made by bolts coming through holes *C*. After the planing had been done the casting was placed on a surface plate and holes *D*, at each end of the casting, were carefully laid off. After fastening the jig to the carriage of a lathe, so that the centers of holes *D* came in line with the lathe centers, we were ready to proceed. The finished holes were to be bushed with hardened steel bushings with holes ⅝ inch diameter, the bushings to be a forced fit into the casting.

I first used an ordinary ¾-inch drill which was held in the lathe chuck, and with this drilled the first two lugs 1½ inches wide. After this operation the blacksmith welded a rod, 3 feet long, of 1-16 inch diameter cold-rolled steel, to a straight shank ¾-inch drill, leaving the weld quite a little large. After tuning up the drill and making the extended part run true with it, I turned off the surplus stock about the weld, leaving a good running drill about 3 feet 6 inches long. With this drill I was able to bore the remaining lugs. The jig was about 3 feet long.

The holes, being drilled in cast iron, were by no means true—that is, the holes in the lugs did not line up with each other. Our problem now was how to get all the holes in line, as that was the prime object of the jig. Fig. 2 shows a boring bar made from 11-16 inch cold-rolled stock. The holes *A* for cutter *B* were drilled alternately at right angles and spaced the same as the lugs on the casting. The small holes *F* were for a taper pin driven against the cutter and acting as a key. When one hole was machined true, it was necessary only to provide a temporary bushing in the first hole, this bushing acting as a steady-rest for the bar while hole No. 2 was being machined, as shown by Fig. 3.

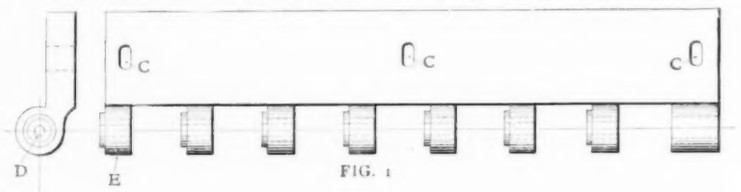


FIG. 1

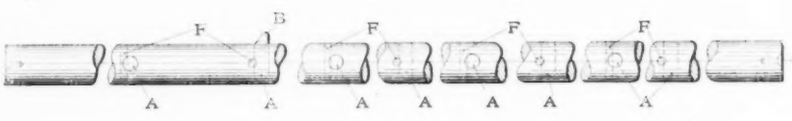


FIG. 2

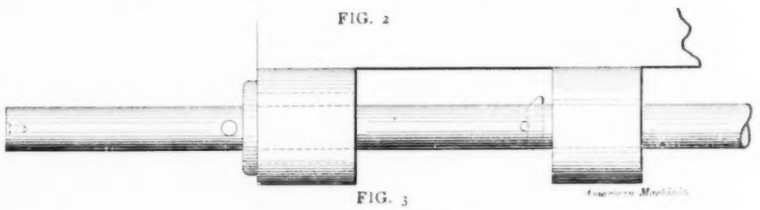


FIG. 3

BORING HOLES IN A JIG.

After each hole had been bored true with the preceding one, the cutter was removed

by driving out *F*, and put in the next hole, corresponding to the lug to be bored next and the temporary bushing was fitted to the hole last finished. By continuing this process until each hole had been properly worked, a very accurate result was obtained. I forgot to mention that a steady-rest was used, as close to the cutter as the travel permitted, during the boring of the first lug. JOS. N. GERMAIN.

Planer Troubles—Leveling Planers—A Three-Legged Planer.

Editor American Machinist:

Your recent very interesting article on planer building in the Gray shops reminds me of some experience I had covering some of the points mentioned. This planer was an old, in fact a very old, one. It boasted of but one belt and no automatic feed for the vertical slide. It was originally 36 inches wide, but had been widened to 50 inches. In widening it they did not get the front faces of the uprights square with the bed, or in the same vertical plane. We noticed that it was impossible to run a cut across any job and have it gage anywhere near right; particularly when using a long extension tool, which had to be used a good deal. In this case the cut was out as much as 1-16 inch in 36 inches wide. I had noticed that the planer hand did a good deal of setting of the crossrail; this he did with a surface gage to the under side of it, and if the cut did not come out right he would attempt to readjust it again. I had him set the crossrail by gage to the platen; after being so set we tried it with a tool in the tool slide, and it showed considerable error; by trying it with a tool in the long extension the error was still more pronounced—in fact about as much as the work was usually out of truth when using it. This test at once showed that the trouble was in the front face of the uprights not being in the same vertical plane; this twisted the crossrail, and of course explained the peculiar action. We found that one upright was over 3-16 out with the other in a hight of about 40 inches, and after this was corrected we had no further trouble from this source.

While those leveling blocks mentioned are no doubt a great convenience to keep a planer properly leveled, I don't think they go to the bottom of the trouble. What is considered *level* anyway? Where can you find an instrument around a machine shop which will tell us how close we really are within limits now usually employed in other lines of machine construction? What are the permissible limits in the case of leveling a machine tool? Take the case of a planer with, say, 8 feet or points, or rather planes, of support; doesn't it require lots of guesswork to determine whether each foot is taking its full share of the load and no more? And again, if the surface of each foot is large, as in the case of a cabinet, is it not possible to put the strain where it was not intended to be, if the man who sets it up happens to be a poor guesser?

Then suppose it has been set up as well as it is possible to do so, on a good stone or concrete foundation, and the feet bedded on sulphur or lead (and about 99 out of 100 don't), even then there is no positive assurance that the tool will remain properly set indefinitely; as adjacent walls or heavy tools, columns or sewers can have an influence in this respect. When such a tool or floor does settle, how far can it go before some of the feet have "no visible means of support"? And how will it affect the correct operation of the tool?

I think there are too many feet on the tools and the beds are not stiff enough; in other words, wood and dirt are expected to hold up what the iron bed should provide for. Cabinet supports are made of box section with shelves and partitions; why not planer or lathe beds? and what are cabinets good for anyway? They certainly don't make the machines stiffer, even if they do look clumsy.

Some day there will be a planer brought out with just three feet on it; and they won't be big feet either; one under each housing, wide apart, and one toward the other end; so distributed that each will bear just one-third of the load any and all the time, whether the floor settles or not. This bed will be of a box section, with just holes enough through it to get out the cores and let through the chips and get in the machinery. This machine can be set on any old floor, will be ready to do business as soon as you can get the belts on, and will keep right at it in the right way, no matter how much it settles, so long as the belts stay on.

GEO. J. MEYER.

The Amended Patent Law and Foreign Inventors.

By a recent act of Congress the patent laws of this country have been so amended as to allow applications to be filed in the United States for letters patent by inventors who have previously filed an application or secured a patent for the same invention in a foreign country, which, by treaty, affords similar privileges to the citizens of the United States. The law, as it now stands, permits the taking of the necessary oath before any authorized foreign officer, providing that proof of his authority is made by certificate of the foreign representatives of the United States.

The act also allows foreign executors or administrators to apply for patents upon the right of deceased foreign inventors and extend the privilege to filing caveats in interference cases to foreigners, and by this last provision the United States no longer discriminates against foreigners in this respect, as there has long ceased to be discrimination in respect to applications for letters patent.

It is required of the inventor that his application in this country must be filed within twelve months from the date of his application for a foreign patent. The application will have the same force and effect as if filed in this country on the same date on which the application was made in the foreign country, provided it is filed within the required twelve months.

Belgium, Denmark, France, Great Britain, Italy, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and Tunis have adopted legislation giving full force and effect to the provisions of this act.

A. F. TENNILLE.

Spring Meeting of the Mechanical Engineers.

Secretary Hutton has sent out the preliminary notice of the spring meeting of the American Society of Mechanical Engineers which will be held at Saratoga beginning June 22. Papers to be presented at the meeting must be in the secretary's hands by April 20 and applications for membership to be acted upon at the meeting should be completed by May 1. A feature of the coming meeting will be visits to the Schenectady Locomotive Works and the works of the General Electric Company, and it is suggested that papers on shop management and kindred topics will therefore be of special interest and value.

Monthly Meeting of the Mechanical Engineers.

The next monthly meeting of the American Society of Mechanical Engineers occurs on Tuesday evening, April 7, at the house of the society, 12 West Thirty-first street. Mr. Wilfred Lewis will read a short paper on the "Pich Process for Brazing Cast Iron," illustrated by examples and results and followed by general discussion. The attendance at these meetings this season seems to assure their permanent success.

The *Wood-Worker* tells of the counting of fifty-two knots in one door of a lot made for export to Germany. The Germans should either refuse to buy such doors, or, buying them, should say as little as possible about them. Remarks derogatory to American manufactures come with little grace from those who continue to buy the inferior articles. Doors with fifty-two knots would not sell with us. We make doors without knots, and can supply them if an equally profitable market is open for them, so that it is the foreign customer and not the American producer who controls the situation. If the foreign purchaser really wants the inferior grades while still abusing them, he has only to continue to buy them, but he can also have better goods or the best goods on the same terms, whether it be doors or machine tools.

An enterprising correspondent of the New York *Journal of Commerce*, who evidently thinks he means to keep well informed, asks whether any locomotive driving wheels are made in the United States.

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Inventions by Employees.

In another part of this issue we print a form of agreement which draftsmen, foremen and some other employees of a certain large engineering establishment are being asked to sign and which ought to be of considerable interest to all who are connected with such establishments in any capacity. We do not know the name of the concern employing this form of contract, but are informed that it is one of the largest in the country.

In brief the contract, after reciting the fact that the employee, by reason of his employment and the nature of the work he is to do, will come into possesion of certain knowledge concerning the business which it is not desirable that competitors should possess, binds him not to divulge such information to anyone.

The rest of the agreement relates to inventions and to title in patents thereon, and provides that any invention made by the employee pertaining to the company's product or work shall be made known to the company or its representative, and if thought worth while by the company a patent is to be taken out at the expense of the company, which is to have exclusive right to its use so long as the inventor remains in its employ. Should he leave, however, the right ceases to be exclusive. It provides further that when the company desires to obtain full control of the invention it can do so by payment of a sum to be agreed upon, and this may be done either during the continuance of the employment or after, the company having first right to purchase within a specified time, after the expiration of which the employee is at liberty to dispose of his invention to anyone else.

Naturally, there is some difference of opinion between those concerned as to the propriety of signing such an agreement and a good deal may be said on both sides of the question. It is quite certain, however, that it is much more fair to an employee than is the position assumed by some employers, *i. e.*, that all inventions made by an employee belong to the employer absolutely. True, the courts do not sustain such a contention, but it is often insisted upon, nevertheless, as a condition of employment or of continuation in employment. As such things go, it seems to us to be a very fair agreement for both sides. We presume only those employees are asked to sign it whose work is of such a nature as to be likely to lead to inventions connected with the work—in other words, employees a part of whose duty it is to study to improve and to invent and who presumably are paid for such work in part or in whole. And even in this they can at any time sell to the company any invention of theirs at as high a price as anyone else will pay for it by simply quitting, and probably that is what a man would do in case he had gotten up an invention of great importance.

Cheap American Files in England.

A British correspondent of the *Iron Age* says that a Sheffield firm has written a letter to a British newspaper, in which letter surprise and anger are shown at the doings of American file manufacturers in England. The letter is as follows:

"Dear Sir: A little while ago you took a very wise lead in pointing out to the public the misleading statements with regard to the export development of American manufactures. May we call your attention to another point in this expansion which seems to be overlooked.

"American file manufacturers are doing an 'export business,' but on what lines?

"Here is an example:

"Half-round bastard files, 6 inches long, are sold inside their own country to large consumers at 70 per cent. discount off a price-list adopted by the file manufacturers of the United States, dated November 1, 1899.

"This list gives the price of these files at $6.10 per dozen, so that their price to meet the home buyer is practically 7 shillings 6 pence per dozen net, and these same manufacturers, to do 'an export business,' sell these same files here at the Sheffield standard list price, which is 7 shillings per dozen, and from this they quote 70 per cent. discount.

"Is this selling goods or is it giving them away? Could not any nation do an export trade on such lines as these?"

It seems that *Commercial Intelligence*, which published this letter originally, commented upon it, and this editorial comment the correspondent of the *Iron Age* finds "quite delightful," and he says:

"It points out that 'export trade on such lines is of the gravest disservice to the countries which practice it. To sell more cheaply to the foreigner than to the home consumer is a disgrace to the exporter.' I, of course, cannot tell how far the statements in the above letter are true. But, assuming that American files are being sold under cost, two comments may be made. In the first place, that a British commercial paper should give prominence to the fact that American file manufacturers are selling their files under cost, I cannot understand. Clearly, the buyers of files will not be slow to take advantage of the position. My second comment is, however, that if this were the case, sooner or later American exporters would have to advance prices. The moment they did this there would come the usual cry that no sooner is a substantial trade secured than prices are advanced. This leads to irritation and loss of trade."

There is, it seems to us, an awful lot of tommyrot about this matter of export prices. The fact is that manufacturers of all countries, including Great Britain, have at times sold their products abroad at lower rates than at home. If a man really owns a lot of files—if they are his by moral right and legal title, then he has a perfect moral and legal right to dispose of them

upon any terms that may be mutually satisfactory to himself and to the buyer. If conditions are such that he can get higher prices in one country than in another, he has a perfect right to get them and would be foolish not to do so. There is not an iota of evidence, so far as we know, to show that the American files sold in Sheffield are sold below cost of manufacture, and in the absence of satisfactory proof to the contrary it is fair to assume that they are sold at a profit. We Americans have been maintaining that our systems of manufacturing enable us to produce many lines of goods at a lower cost than they can be produced by any other system. If this claim is true, then why should anyone be surprised that goods manufactured here should be able to compete with similar foreign products? And how does the fact that they are able to compete make it incumbent upon the American manufacturer to sell at similar low prices at home when he can get higher ones? And wherein does a manufacturer exhibit wickedness or depravity by following this plain law of trade? If the manufacturer who can do this thing, and does it, claims that he cannot do it—that his goods cost more than those of foreign manufacture, etc.—then he of course says what is untrue, and his is a case for the moralist, and if he makes use of this lie to advance his own interests at the expense of others, then those others should take such measures as are possible to protect themselves from such imposition; but the idea that a manufacturer should, from altruistic motives, or any other, refrain from getting what he can in any country for goods that he makes and that belong to him is grotesque. If conditions are such that prices can be obtained here that are higher than those that can be obtained abroad, how can a manufacturer be censured for taking full advantage of hose conditions?

A New Labor Union.

We have received the prospectus of a new organization with headquarters in Elmira, N. Y., and which society sets forth its objects as follows:

1. To protect independent workmen in their independence.

2. To oppose strikes and lockouts, boycotts and blacklists.

3. To obtain higher wages, shorter hours, and better conditions, by:

(a) More intelligent application of our energies.

(b) Harmonious co-operation with our employers.

(c) Legitimate business methods.

4. To furnish favorable conditions for training apprentices, in order that our boys may become successful workmen.

5. To compel officers of the Local, State and National governments to enforce the laws and to compel labor unions and others to observe the laws.

6. To protect members against unjust treatment from employers by due process of law.

7. To provide an employment bureau for members.

8. To provide means for members to guard against sickness and accident.

9. To provide educational opportunities for all members.

10. To provide in all lawful ways for the welfare of the members and the maintenance of their rights under the laws and the Constitution of the United States.

An organization having similar avowed objects and principles has been started at Anderson, Ind.

Title to Inventions and Patents by Employees.

The following is a form of agreement being used by a large machinery building establishment. Presumably it was drawn by a competent lawyer:

This agreement made this .... day of .... A. D. 19.. by and between ..... Co., a corporation organized and existing under the laws of the State of New Jersey, party of the first part (hereinafter designated as first party) and .... of ...., party of the second part (hereinafter designated as second party) and manufacturing various kinds of machinery, and in and about said business has acquired a great number of plans, models and machinery for the manufacture of said machinery, which it endeavors to keep from the knowledge of its competitors, as trade secrets; and

Whereas, second party .... employed by first party in the capacity of .... and by reason of such employment will be given access to such secret plans, drawings, models and machinery, and will become informed of the methods used by the first party in the operation of its shops, and in the manufacture of machinery, and the extent and character of its business; and

Whereas, by reason of the information so to be furnished and of the opportunity so to be given to acquire knowledge of the first party's aforesaid plans, drawings, models and machinery, and methods used by it as aforesaid, the second party may be enabled to invent or devise, and may invent or devise improvements in the methods employed, or in the machinery used, or in the machinery manufactured by the first party, or in the apparatus connected therewith;

Therefore, in consideration of such employment, and as an inducement thereto, and in further consideration of the sum of $1.00 to him in hand paid, the receipt whereof is hereby acknowledged, the second party hereby covenants and agrees with the first party as follows:

First: That during said employment he will devote his time, best skill and ability to the interests of the business of the first party and that he will not directly or indirectly divulge to any person, firm or corporation any information as to the said plans, drawings, models or machinery of first party, or methods employed by it in the operation of its business, or in reference to its machinery, or the manufacture of machinery or any apparatus connected therewith, or in the conduct of its business.

Second: If the second party during the said employment shall devise or invent any improvement in the machinery or processes employed in the works of first party, or in the machinery manufactured in its works, or used in connection with the machinery used, sold or manufactured by first party or in any apparatus connected therewith, the second party will immediately after making such invention disclose the same to the manager of the department in said works in which second party is then employed, or to the person who has charge of such matters for first party, and if it is so desired by first party, the second party will, at the expense of first party, make application for Letters Patent from the United States, or any foreign country or countries, for such invention or improvement, and will by formal assignment grant and convey to first party, its successors or assigns, the permanent shop right or license under such patent, patents or applications; the same to cover any or all of the first party's shops now located or to be located within the United States or elsewhere; and

Said license or shop right when so given shall be an exclusive right or license, and shall operate as long as said second party remains in the employment of first party, after which it shall not be exclusive.

Second party further agrees, at any time during the continuance of his employment or at other times as are provided herein, that he will at the request of said first party, its successors or assigns, by formal agreement convey to said first party, its successors or assigns, all right, title and interest in and to such invention in further consideration of the payment to him by first party of such sums of money as may be mutually agreed upon. It is also understood that if other parties desire to purchase such invention or inventions, the first party shall have the first opportunity of making such purchase at a price equal to that offered *bona fide* by any other party.

Said second party further agrees with said first party, its successors or assigns that whenever he leaves its employ, the said first party, its successors or assigns shall have first opportunity to purchase such patents, rights under patents or applications for patents, which he may then own or control, and shall have such option for the purchase of same for a period of .... days from and after the time said second party leaves the employ of said first party, its successors or assigns.

It is also agreed by both parties hereto that in case said second party shall have submitted to the said first party or its proper representatives, in accordance with this agreement, any invention or design, and said first party decides not to avail itself of the options first above mentioned and herein given within sixty (60) days and the option last above mentioned within ....

days, then and in that event the said second party shall make such disposition and use of such invention as his will may dictate, and as though this indenture had not been made.

In witness whereof the first party has signed its corporate name hereto, attested by one of its officers; and the second party has also hereunto set his hand and seal the day and year first above written.

..... Co.

Attest: ..... By .....

Witness: .... [SEAL]

Some New Things.

NEW SCREW WRENCH.

In this wrench the screw is entirely clear of the bar, the latter, instead of being milled out to receive the periphery of the knurled head, being provided with a

FIG. 1. NEW WRENCH.

hardened steel ball, which bearing, as shown, in a groove in the hardened face of the head, prevents end movement of the screw. This arrangement not only makes possible a stronger shank, but also gives a better support for the movable

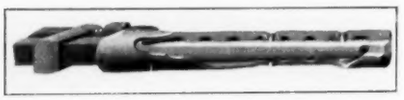
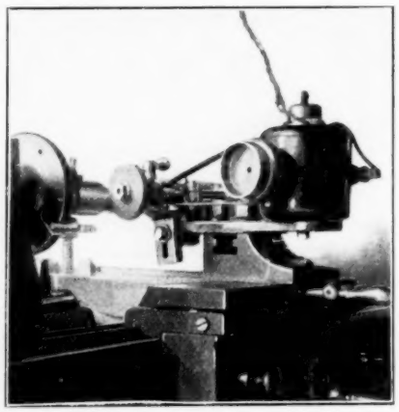


FIG. 2. WRENCH HANDLE.

jaw, as the screw is here brought much nearer the center of the latter. The handle is, as indicated, a metal case or sleeve which is fitted over the shank or bar and secured by two rivets and by upsetting the tip of the bar in the taper hole at the end of the handle. This wrench is made by the Coes Wrench Company, Worcester, Mass.

UNIVERSAL GRINDING ATTACHMENT.

This grinder may be used in the lathe on punches, dies, reamers and other work requiring either external or internal grinding, and in the planer on flat, square or angular work. It may also be mounted on the bench and used for grinding tools and for other work of a similar nature. It is driven by a 1-6 horse-power motor, the current being taken from a lamp socket, and the motor controlled by a switch which is placed at the top of the casing. The motor and wheel spindle are carried by a base-plate which may be clamped in any position on the lathe cross-slide, or on the planer head, and the bracket for the wheel spindle is adjustable at the front of the base to suit different sizes of machines. The motor shaft and the spindle carry two-step cone pulleys connected by a ¾-inch belt, and the wheel is driven at 7,000 and 10,000 turns per minute. The spindle runs in a sleeve and has in the latter a longitudinal movement of 3 inches, this end movement independent of the machine itself being useful when grinding lathe centers and similar work, or in inter-



UNIVERSAL GRINDING ATTACHMENT.

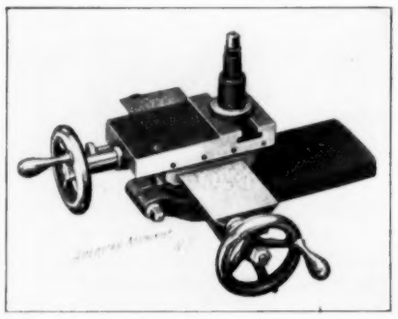
nal work ground at an angle. A set of emery wheels is furnished with the grinder and also a chuck for holding small emery sticks. The machine weighs 22 pounds; it is made by the Throop Perforating Company, Buffalo, N. Y.

REVOLVING DRILL STAND.

A stand or holder, for drills from No. 1 to No. 60, has recently been brought out in which the drills are placed in two circular plates mounted one above the other upon a vertical spindle secured in the base of the stand. The plates are free to turn on the spindle and the drill required may be found instantly, as each drill has in front, on the beveled edge of the plate, and in large figures, its correct gage number. The stand is of metal throughout and nickel plated. It is made by the New Process Twist Drill Company, Taunton, Mass.

SLIDE REST.

L. E. Rhodes, of 32 Union Place, Hartford, Conn., has brought out a new slide rest to be used on speed lathes, etc., which



SLIDE REST.

is shown herewith. It is of the standard modern construction, so far as protected screws, etc., are concerned, its novel points being the stop screw to be used in setting the rest either for the duplication of work or in screw cutting and the method of clamping the rest at a given angle, the construction of this being clearly indicated in the engraving.

SWING GRINDING ATTACHMENT FOR DRILL GRINDER.

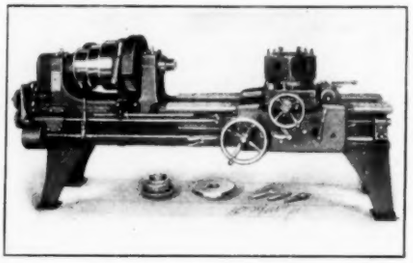
The half-tone shows an attachment which the Wilmarth & Morman Company, of Grand Rapids, Mich., have designed for their "New Yankee" drill grinder, and which is intended for grinding punches, dies, keys, and other small parts. The attachment consists of a table and its support mounted on an arm and arranged to be oscillated on the same, a weight secured under the support keeping the table right side up. A cup wheel is used with this attachment, the work being moved back and forth across the face. A collar, adjustable on the stud, limits the movement of the table toward the wheel, and a shield covering these parts keeps them free from dust. Two tables are furnished; one is

SWING GRINDING ATTACHMENT FOR DRILL GRINDER.

flat with a ledge at the side against which work may be squared, and the other is provided with a V for holding round work. These tables are readily changed and without the use of a wrench. They are adjustable up and down and may be set at any angle. The makers are prepared to furnish this attachment on a column without the drill grinder but with a plain wheel and rest, for surface grinding, instead.

24-INCH UNIVERSAL TURRET LATHE.

This tool is designed for machining valves, gears, pulleys, etc., and also for making machine parts from bar stock, the



24-INCH UNIVERSAL TURRET LATHE.

spindle being provided with a 2¼-inch hole. The head has friction back gears controlled by the lever at the front. The turret carriage has a longitudinal travel of

32 inches and the turret a cross travel of 12 inches. The turret is of hexagonal form, and is so constructed that work may be passed directly through it. Geared feeds (with independent stops for each turret face) are provided, giving six changes for both longitudinal and cross feeds; and a lead screw is fitted to the machine for use in cutting threads. The machine is furnished with a friction countershaft; and a taper attachment is fitted when so ordered. It will be noticed that the headstock is cast solid with the bed. The weight of this tool is 4,500 pounds. It is built by the Warner & Swasey Company, Cleveland, O.

PORTABLE HYDRAULIC PRESS.

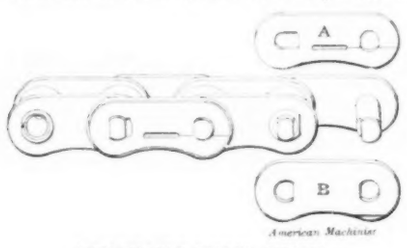
The half-tone shows a portable hydraulic press designed for pressures up to 450 tons. In operation it may rest on the flat base or it may be lifted by the crane to any desired hight. The work is held

PORTABLE HYDRAULIC PRESS.

by I-beams and side bars, the latter being placed in the openings at either side of the press. The liquid for the hand pump by means of which the ram is operated is supplied from a tank in the base. The ram is returned to position by rack and pinion operated by the lever at the front end. For lighter service a somewhat different type of press is made, this being built on a truck. Chas. F. Elmes Engineering Works, Morgan and Fulton streets, Chicago, Ill., are the builders.

NEW DETACHABLE ROLLER CHAIN.

The construction of this chain is clearly indicated in the cut, and little explanation



DETACHABLE ROLLER CHAIN.

is necessary, the spring-steel locking plate, which is split at one end and which fits into grooves formed in the rivets, being shown in position on the chain and also removed at *A*. It will be noticed that the regular side plates, one of which is shown at *B*, cannot turn on the rivets, owing to the irregular shape of the holes. The chain is detachable at any point. It is made by the Whitney Manufacturing Company, Hartford, Conn.

Questions and Answers.

Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer by mail.

(1) D. W. R. asks: Will it be safe to run a cast-iron disk 12 inches in diameter by ½ inch thick, 1,950 turns per minute, disk to be turned true? A.—As this will give a surface speed of about 6,120 feet per minute (slide-rule calculation) it will be well within the limits of safety, and we should not hesitate to run the disk at that speed if there is reasonable assurance that the disk is sound. Its thickness will make no difference.

(2) I. F. Z. asks: In planing a valve seat and valve, which way should the tool marks run, the same way the valve travels or at right angles to the valve travel? and should both seat and valve be planed the same way? A.—Years ago "Chordal" called attention to the fact that the reason cylinders start to work and run all right without being immediately cut to pieces is that they are bored in such a way as to leave the marks running at practically right angles to the motion of the piston. He did not, we believe, mention the fact that the rings are also finished at right angles to their motion, but it is not unlikely that that also has something to do with it. We believe that the same principle applies to valves and valve seats and that the tool marks should run at right angles to the motion on both valve and seat. 2. Where the chest is too large to get on the planer bed to plane it crosswise, in such a case the valve seat would be planed in the direction of the valve travel, then which way should the valve be planed? A.—We believe that the valve should be planed as before at right angles to its travel and we believe it would be better in such a case to break up the tool marks on the valve seat if possible by scraping. We believe it is unnecessary, however, to scrape valves or seats to a fit where planing can be as well done as it ought to be, and we think that the scraping of such surfaces where they have been well planed is a waste of labor.

Technical Publications.

"Turning and Boring Tapers." By Fred H. Colvin. 23 5½x8-inch pages with 21 illustrations. The Derry-Collard Company, New York. Price, 25 cents.

This pamphlet is announced as No. 1 of a series of practical papers. The different methods of expressing tapers are explained, together with the leading methods of turning and boring tapers and of obtaining the taper wanted. A table of equivalent tapers in degrees and in fractions of an inch per inch and per foot, and a table of Morse tapers are included. Few things that we have seen in technical literature have pleased us more than this. There is an immense number of shop subjects that can be treated in this way, and if future numbers of the series are as well selected in subject and as well treated as this, the result will be of decided benefit to mechanics and we doubt not of corresponding success from the publishers' standpoint. While the price is low, there is nothing cheap about the pamphlet. The engravings are new and the paper and presswork are first-class.

Personal.

W. E. Moore has resigned his position as general superintendent and engineer of the Augusta Railway & Electric Company, and the Gas Light Company of Augusta, Ga., to take effect as soon as his successor can be appointed, and is taking up similar work with the West Pennsylvania Railway & Lighting Company, of Pittsburgh.

H. J. Bingham, M. E. and architect, has associated with himself his brother, F. E. Bingham, formerly with the E. P. Allis Company, of Milwaukee and later with the Boston Elevated Electric Railway, under the name of The Bingham Engineering Company, and will continue the work of power plant, factory and machine designing at Akron, O.

M. E. White, for several years foreman of the toolroom and later superintendent of the Parish & Bingham Company, Cleveland, Ohio, has removed to Racine, Wis., where he has acquired an interest in the stamping works formerly known as the L. B. Baker Manufacturing Company, but which was recently reorganized and the name changed to Advance Manufacturing Company. Mr. White will hold the position of secretary and superintendent with the new concern.

Obituary.

Samuel W. Pierce, for many years chief engineer of the Joy Steamship Line, died March 23, fifty years old.

George D. Haworth, inventor of the first (?) corn planter and other agricultural implements, died at Decatur, Ill., March 24.

Simon D. Cassel, electrician for the Harrisburg (Pa.) Traction Company, was recently killed by the bursting of a 16-inch emery wheel in the repair shop.

A. A. Barnes, ex-president of the Peck, Stowe & Wilcox Company, died March 23, fifty-eight years old. He was an ex-representative in the Connecticut General Assembly.

James Heman Snow, owner of the Snow Steam Pump Works, of Buffalo, and secretary and director of the International Steam Pump Company, died in this city, March 26.

John C. Schrader died in this city, March 25. Mr. Schrader, who was a native of Denmark, came to this country about thirty years ago and at first was employed as a machinist, later and for many years being connected with the Atlantic Dynamite Company. He invented many improvements in the manufacture of explosives.

Chief Engineer A. W. Morley, United States Navy, retired, died in Brooklyn, March 24. He was born in Hartford, Conn., and entered the navy at the beginning of the Civil War, reaching then the grade of First Assistant Engineer and becoming a Chief Engineer in 1882. In 1889 he was selected as inspector of machinery on the battleship "Maine," then under construction, and he became her first Chief Engineer. He was retired in 1896.

Commercial Review.

NEW YORK, Monday, March 30, 1903.

March closes in the machinery trade with developments that have given the greatest satisfaction. From inquiries we have made, the business transacted leaves no doubt whatever that it greatly exceeded in volume that done during January and February.

As a matter of fact, this state of affairs tallies with expectations that are generally entertained at the beginning of a new year. As we had occasion to remark in our January review of the machinery market, that month is always expected to bring about only a fair amount of trade at the best, with February bringing about a slight improvement, and March counted upon to make up for whatever disappointments both months may have furnished.

That March met expectations in this direction can be truthfully stated. Apart from the fact that it has been a very good month for machinery merchants, it can be given the additional credit of being far more satisfactory in the matter of results than the same month last year.

The machinery trade at the present time has as strong an undertone as at any time during the past year. While a short time ago persons could be met who were inclined to indulge in pessimistic utterances, at least in a mild way, people of that way of thinking are now either impossible to find, or have come to the conclusion that the least said is the soonest mended. At any rate, we hear nothing but complimentary allusions to current trade, and the most optimistic views expressed as to the outlook. As time passes, machinery men derive the greatest encouragement from the fact, that each month finds their business better off than the one which went before it, and as long as they meet with this experience, the more reason have they to congratulate themselves on one hand, and the less cause for worry on the other.

Machine-tool men were particularly pleased with the month's developments. On all sides we are informed that March was unquestionably more profitable for them than the two months which preceded it, and which, as we had occasion to chronicle when we reviewed them, surpassed expectations. Some big machine-tool projects are fast getting into shape for the trade. This is particularly the case with the Westinghouse Electric & Manufacturing Company's proposed equipment for its East Pittsburgh shops, and concerning which some important announcements can be expected in the near future. The railroads are again entering the market with some good orders for machine tools, although they have been steady buyers for some time past. As for the orders calling for one and two machine tools at a time, business of this character may be said to have attained the high-water mark recently. Prices were never firmer than they are now.

In the electrical machinery line, business could not possibly be in a more prosperous condition. Orders calling for equipment on a large scale are numerous, both from domestic and foreign sources. Trolley companies are particularly well represented in the orders that are being placed, and are adding to their rolling stock, or increasing their power-house capacity to a large extent. In engines and boilers, present conditions are very favorable, and the outlook regarded as brighter than some were inclined to believe a month ago. The machinery supply business in all its branches is marked by a heavy demand, with prices inclined to be a little stiffer.

The Lidgerwood Manufacturing Company, of 96 Liberty street, is making notable headway with the plans for the construction of its new $2,500,000 plant at Newark, N. J. During the week the city authorities acted favorably on the company's petition to close several streets, preparatory to beginning work on the plant. The details of the latter, which are now practically completed, call for the erection of a foundry 120x500 feet, with an extension of 75x80 feet. The company hopes to have this in operation in a year at the utmost. The orders for the equipment have not been given out yet. The largest single building will be the erecting shop, which will be 120x720 feet. The light and heavy tool shops, and blacksmith, boiler and pattern shops, will each be 75x267½ feet, and will directly adjoin one another. The shipping department will form a building of the same dimensions also. The office building will be 50x50 feet, and will be three stories high.

The machinery district of this city is likely to undergo a great change during the coming year. Investors and speculators in real estate have been very active during the past few months getting options on property which forms the headquarters of machinery men, on Liberty, Cortlandt and Dey streets, from Broadway to West street. In this column last week we noted the acquisition by the New York Telephone Company of the building at 9 Dey street, for many years occupied by James Beggs & Co., manufacturers of engine, boiler and sawmill tools and supplies.

A contract for the largest interlocking installation ever placed in America, and probably much the largest in the world, has recently been given to the Union Switch & Signal Company for the St. Louis Terminal. The Westinghouse electro-pneumatic system will be adopted, and the contract calls for 258 working levers, with fifty-one spare levers, which will perform 748 functions.

CHICAGO MACHINERY MARKET.

A call at any one of the three or four large machinists' supply houses at Chicago would immediately dispel any idea that trade in that line is not brisk. There are invariably at these stores more customers than salesmen to wait upon them, and men and boys often, with the grime of the shop upon their faces, stand about patiently until their turns come. Talk to the manager and he will tell you they are doing better business than ever before. His statement is amply borne out by the circumstances, morning, noon and night.

Of a dozen representatives of manufacturers of various kinds of machinists' supplies interviewed, the invariable report was that business now exceeds that of a year ago, and some of them will confidentially say they think this is due, at least in part, to the fact that they are getting business at the expense of their competitors. Some note an increase of nearly one hundred per cent., though that extreme gain is not common, and ask how it can be anything else than a gain of that sort, when the aggregate business of the country has perhaps increased only 5 or 10 per cent. as compared with a year ago. But the uniformity of the reports of a most excellent trade points inevitably to a large gain in the use of these supplies. One representative notes the fact that their trade for March last year was exceptionally heavy, due to the securing of one or two quite large orders, but that this year their March business is considerably above that of a year ago, and with no exceptionally large orders. He says the current business is rather notable for the number of orders, many of the buyers being the proprietors of new machine shops started up in the West.

Sellers of transmission of power supplies say business is brisk and that there is distinct improvement also in other lines of goods for shop equipment. The hardware or commercial trade is relatively not so good in the country, but even in that line there is nothing which approaches dullness. Business conditions in the metal lines are, on the whole, exceedingly satisfactory.

The Machinists' Supply Company report business at their new branch house recently opened at Pittsburgh, Pa., entirely satisfactory. At Chicago their March trade is above any preceding month and that of the quarter just ended is largely ahead of any similar period. The E. A.

Delano Company says trade in their regular lines is increasing very notably. With Samuel Harris & Co. trade was never better than now. The Chicago house of the L. S. Starrett Company is so busy filling orders that their stock can scarcely be maintained, many of the goods arriving going directly from shipping boxes to fill orders without being placed on the shelves. And these are only typical examples of the general conditions reported.

Quotations.

NEW YORK, Monday, March 30.

New York prices for Northern and Southern irons for the first half of 1903 are as follows:

Northern:	
No. 1 X	$23 25 @ $24 75
No. 2 X	22 00 @ 22 75
No. 2 plain	21 00 @ 21 75
Southern:	
No. 1 Foundry	23 25 @ 23 50
No. 2 Foundry	22 25 @ 22 50
No. 3 Foundry	21 50 @ 22 50
No. 4 Foundry	20 50 @ 21 50

Bar Iron—Base sizes—Refined brands, mill price on dock, 1.95c. upward in carload lots. Smaller quantities from store, 2.15 @ 2.30c.

Tool Steel—Base sizes—Good standard quality, 7c.; extra grades, 10c. and upward.

Machinery Steel—Base sizes—From store, 2.10 @ 2.25c.

Cold Rolled Steel Shafting—2.90c. from store for base sizes.

Copper—Lake Superior ingot, 14¾ @ 15c.; electrolytic, 14¾ @ 15c.; casting, 14½ @ 14¾c.

Pig Tin—In 5- and 10-ton lots, f. o. b. New York, 30¼ @ 30¾c.

Pig Lead—4.07½c. in 50-ton lots.

Spelter—5.50 @ 5.75c.

Antimony—Cookson's, 8½ @ 8⅞c.; Hallett's, 6¾ @ 7c.; other brands, 6½ @ 6¾c.

Lard Oil—Prime City, 85 @ 87c., according to brand and quantity, ranging from one barrel up to large lots.

New Catalogs.

McCrosky & Huber, Cincinnati, Ohio. Reamers, 6x3½, pp. 9, paper.

Butler Chuck Company, Greenfield, Mass. "Butler" patent drill chuck; circular.

Challence Machine Company, Philadelphia, Pa. Grinding machines, 6x9, pp. 52, paper.

Kearney & Trecker, Milwaukee, Wis. Milwaukee milling machines. 6x9, pp. 19, paper.

National Engine Company, Rockford, Ill. Gas and gasoline engines, 4½x8, pp. 10, paper.

Pike Manufacturing Company, Pike Station, N. H. India oil stones. 3½x6, pp. 12, paper.

E. W. Bliss Company, Brooklyn, N. Y. "Bliss-Heath" pumping engines. 3½x6, pp. 16, paper.

D'Olier Engineering Company, Philadelphia, Pa. Steam turbines and turbine machinery; folder.

Coatesville Boiler Works, Coatesville, Pa. "Boilers and Plate Metal Construction." 3½x6, pp. 16, paper.

Chattanooga Machinery Company, Chattanooga, Tenn. The Catlin keyseating machine. 8x6, pp. 16, paper.

The Goheen Manufacturing Company, Canton, Ohio. "Carbonizing Coating" for structural steel; folder.

H. W. Johns-Manville Company, 100 William street, New York. Asbestos boiler coverings. 4½x7, pp. 9, paper.

The Bantam Manufacturing Company, Bantam, Conn. Roller bearings and ball bearings. 4½x7, pp. 12, paper.

Carlin Machinery & Supply Company, Allegheny, Pa. Stock list No. 14 of machinery, engines, etc. 3¼x5¾, pp. 40.

Northern Electrical Manufacturing Company, Madison, Wis. "Direct Current Generators," booklet No. 31, 3½x6, pp. 8, paper.

Meadville Vise Company, Meadville, Pa. Cylinder boring machines of many types; half-tone illustrations. 8x10½, pp. 28, paper.

Philadelphia Pneumatic Tool Company, Philadelphia, Pa. "The care and use of pneumatic tools." Illustrated. 6x9, pp. 8, paper.

Joseph Dixon Crucible Company, Jersey City, N. J. An attractive booklet on the application of Dixon's graphite to automobiles.

Wyman & Gordon, Worcester, Mass. "A Short Story of John Fitch," one of an interesting series of short biographies of noted engineers.

The Plunger Elevator Company, Worcester, Mass. Plunger elevators; detailed descriptions, and illustrations of some applications. 4x9, pp. 15, paper.

Frank Mossberg Company, Attleboro, Mass. "Our Facilities and What We Do." descriptive of the history and the products of this company; profusely illustrated. 6x9, pp. 23, paper.

Weber Gas & Gasoline Engine Company, Kansas City, Mo. Gas and gasoline engines, stationary and portable, mine locomotives, air compressors and pumping engines. 6x9, pp. 72, paper.

Newton Machine Tool Works, Philadelphia, Pa. "A New Method of Keyseating," on the Newton double-spindle milling machine, showing views of work in the machine. 6x9, pp. 11, paper.

Buffalo (N. Y.) Forge Company. "A Comprehensive Engine Test." Report of tests made upon a Buffalo horizontal center crank class "A" engine at the Worcester Polytechnic Institute.

C. W. Hunt Company, West New Brighton, N. Y. Steam hoisting engines. Catalog No. 0117, illustrated. 6½x9, pp. 20, paper. "Electric Hoists," catalog No. 0225, 6½x9, pp. 15, paper.

Cleveland Twist Drill Company, Cleveland, Ohio. Tables of data regarding drills, screw taps, bolts and nuts, etc., printed on heavy cardboard and arranged for hanging up for ready reference.

The "Mobile" Manufacturing Company of America, New York. "The Story of the 'Mobile.'" Illustrations and specifications of various types of steam carriages, wagons and trucks. 6¼x9½, pp. 32, paper.

Reed Manufacturing Company, Erie, Pa. Stocks and dies, pipe taps, pipe cutters, vises and a general line of plumbers' and steam fitters' tools. Printed on coated paper; half-tone illustrations. 7¼x4¾, pp. 48, paper, with attractive cover design.

Hammacher, Schlemmer & Co., New York. General catalog No.180, embracing a complete line of tools for machinists, carpenters, molders, patternmakers, plumbers, painters, masons, etc., and representing tool equipment for practically all classes of tradesmen. Price lists and much detailed information are given. The book is conveniently arranged, neatly printed and profusely illustrated. 5x7½, pp. 809, cloth.

Manufacturers.

The Southern Pacific Railroad will enlarge its shops at Sacramento, Cal.

The Globe Knitting Works, Grand Rapids, Mich., is about to enlarge its plant.

The Tunkhannock (Pa.) Electric Light Company will build a water-power plant.

The Curtis Sash & Door Company, Sioux City, Ia., will make improvements to its plant.

The Royal Handle Manufacturing Company will erect a factory at or near Harrisburg, Ark.

A four-story building, 35x100 feet, is being erected for the Wilkinson Shear Company, Reading, Pa.

The Reliable Match Company, Ashland, O., expects to erect a two-story factory building, 65x175 feet.

The Oakmont (Pa.) & Verona Power, Heat & Light Company will rebuild a plant recently burned.

Nelson Morris & Co., Chicago, are to establish a $1,000,000 packing plant at Kansas City, it is said.

There is being built in Delaware, O., a plant to manufacture gas and gasoline engines and employ 300 men.

A canning factory will be built in Alexandria, Ind. The directors will be S. G. Phillips, F. P. Boyd *et al.*

A large part of the car building plant of the Pennsylvania Railroad at Fort Wayne, Ind., has been burned.

It is rumored that the Pennsylvania Railroad intends to locate car building and repair shops at Jeannette, Pa.

The Memphis (Tenn.) Furniture Manufacturing Company has applied for a permit to rebuild on a larger scale.

It is stated at Johnsburgh, N. Y., that the Garnet Mill Company has purchased a mill site and mining property.

H. E. Bair & Co., Hanover, Pa., cigar box manufacturers, are putting up a building, 120x33 feet, two stories.

An 80 foot addition will be built to the new blacksmith shop of the Pennsylvania Railroad Company at Shellpot.

The Tuckaseege Manufacturing Company, Mt. Holly, N. C., is about starting to build an additional cotton mill.

The contract has been let for two new buildings at the New York Shipbuilding Company's plant, Camden, N. J.

A new office and factory building will be erected for the Bailey, Banks & Biddle Company, jewelers, Philadelphia.

The Westinghouse Air Brake Company is about starting to erect a new foundry, to be 320x65 feet, at Wilmerding, Pa.

Swift & Co., Chicago, propose to build or buy a large packing plant in the Northwest, probably at Seattle or Portland.

A new car barn with machine shop will be erected at Chagrin Falls for the Eastern Ohio Traction Company, Cleveland, O.

It is stated at Gadsden, Ala., that Captain J. M. Elliott will erect two blast furnaces. He also contemplates a rolling mill.

A building permit has been granted for a structure to be erected in Newark, N. J., by H. Ahrend for the manufacture of locks.

Macon, Ga., is to have a $1,000,000 guano and fertilizer plant constructed by the F. S. Royster Guano Company, of Norfolk, Va.

A Newark, N. J., permit has been granted for a factory which will be occupied by the Transparent Cellulose Products Company.

The Pembina Portland Cement Company, Grand Forks, N. D., expects to build a line of railroad 21 miles long and increase its capacity.

New car and general repair shops are being planned for by the Union Traction Company, of Indiana, which is an Anderson and Marion concern.

Common Councilman Matthew Long, of Hazleton, Pa., is trying to secure for that place a factory of the Anderson Water Meter Company.

Charles Sutton, operating a lumber mill at Lincoln, Me., proposes to erect in Stillwater, next fall, a sawmill for turning out box boards, etc.

Officers of the Belmont Iron Works, manufacturer of structural steel, Philadelphia, have been looking for a site for a plant in Chester or vicinity.

A new building which is to be added to the plant of the New Home Sewing Machine Company, Orange, Mass., will be used for the manufacture of needles.

The Allegheny division shops of the Pennsylvania Railroad in Oakmont and Verona are to be improved. A large railroad foundry is said to be in prospect.

A factory building is about being erected at Newark, N. J., for Randolph Felder. R. Felder & Co., of that place, are manufacturers of hardware specialties.

The Union Manufacturing Company, manufacturer of chucks, etc., New Britain, Conn., has applied for a permit to raise a 90x35-foot building one story.

Plans have been made for a four-story and basement manufacturing plant, about 122x65 feet, for Haines, Jones & Cadbury Company, brass founders, Philadelphia.

It is understood that the Brylgon Steel Company, Reading, Pa., has in view the early erection of a plant at New Castle, Del., including a 610x65-foot building.

It is reported that Balfour, Guthrie & Co., of London, England, will open the cement beds at Keese, in Whatcom County, Wash., and build several large factories.

Plans have been completed for a 300x75-foot building and 50x60-foot dry kiln for the Deming-Berry Company, Tacoma, Wash., manufacturer of pulleys, clutches, etc.

It is rumored that the Standard Oil Company will spend $3,000,000 in enlarging its refinery at Whiting, Ind., putting up a new refinery, a can factory, tanks, etc.

An 80x200-foot factory building is to be erected by the Coe Brass Manufacturing Company, Torrington, Conn. The company is now putting up a 50x150-foot, two-story building.

John H. Talge, St. Joseph, Mo., proposes to build a new factory for the manufacture of lounges and mantel folding beds. There will be a private electric plant for power and light.

The National Supply Company, oil well and plumbers' supplies, is considering the enlargement of its Toledo (O.) plant. At a meeting held in Pittsburgh, Pa., a profit-sharing plan was discussed.

The Dominion Packing Company (head office at Montreal, Que.) proposes to build one or more meat packing and by-product plants. It already has bought a plant at Charlottetown, P. E. I.

The Georgia-Portland Cement Company is preparing to build a large plant a few miles from Rock Mart, Ga. W. E. Dorwin, of Chicago, the president, is making his headquarters at Atlanta.

W. P. Anderson and others have formed a company for the purpose of building an iron foundry in Sedro-Wooley, Wash. Besides doing a general foundry and machine business, they will manufacture pulleys.

It is reported that the R. Wallace & Sons Manufacturing Company, silver and plated ware, Wallingford, Conn., will erect an addition to its plant to employ at least 100 more men. Enlargements are also to be made at the works of the International Silver Company.

A permanent factory to build a railway chronograph invented by H. G. Sedgwick may be located in Beloit or Janesville, Wis. Previously the machines will be made at Meadville, Pa. Among those interested in the enterprise are J. M. Bostwick & Sons, of Janesville.

A big cement and wall plaster factory will be erected in Ludlow, Ky. Some capitalists of Cincinnati, O., will be identified with the venture. Louis J. Hauck, a well-known brewer, will be a large stockholder. It will be called the Eagle Cement & Mortar Company.

The Canadian Canners' Consolidated Companies, Ltd., has been formed with $2,500,000 capitalization, proposing to take over the leading fruit and vegetable packing factories in the Dominion, to improve and standardize the product and establish a school of instruction. The head office will be in Hamilton, Ont.

The factory building of Witherby, Rugg & Richardson Company, Worcester, Mass., manufacturers of wood-working machinery, will be doubled in size. The plant will be occupied also by the Hobbs Manufacturing Company, manufacturer of paper box machinery, as the two concerns are now under the same control.

The Mount Clare shops of the Baltimore & Ohio Railroad at Baltimore will be greatly enlarged this year. The company is said to have purchased $500,000 worth, or more, of machinery for its various shops since January, and to be in need of as much more. It is thought that a repair shop will have to be built somewhere west of the Ohio River.

At a meeting of manufacturers in the metal ceiling line, it is reported to have been arranged to erect at Wheeling, W. Va., a plant at which is to be concentrated a large part of the metal ceiling interests of this country. The plant will cost about $500,000 and employ about 1,500 men. The capital stock of the new combination will be $5,000,000.

Wm. R. Sawyer has fitted up, at 227 St. Clair street, Cleveland, O., a factory with new and modern equipment, to be called the Sawyer Gear Works. His five years' lease of the Cleveland Gear Works terminated February 28, G. B. Grant resuming control. Mr. Sawyer may be addressed at his new location relative to bills and accounts extant.

F. B. Gilligan and F. L. Smith, New York engineers, have begun surveys for the development of some 6,000 electrical horsepower on the Farmington River in the towns of Sandisfield and Tolland, Mass. The undertaking is backed by Boston and New York men. The G. L. Straw Company, contractors and engineers, Boston, secured options on the water rights.

The Motor Traction Company is being organized at York, Pa. Dr. J. H. Yeagley, of York, is president; E. B. Van Atta, of New York, vice-president. The plant will be installed and operated in a factory in East York. The object is to manufacture a new device known as the gasoline traction gear, road rollers and hauling trucks. Mr. Morton is the patentee of this device.

The Knoxville (Tenn.) Power Company proposes to convert 20,000 or 30,000 horsepower of the Little Tennessee River into electricity to be conveyed to town for industrial purposes, etc. An English syndicate is expected to finance the scheme, which seems to be definitely taking shape. H. O. Reed, registered at the Imperial Hotel, Knoxville, is secretary-treasurer of the power company.

The Pennsylvania Air Brake Company has been organized, with H. G. Manning as president. He is also president of the Washington (Pa.) Foundry & Machine Company, which plans to build a plant where the air brakes will be turned out. The first move will be to erect a foundry. The officers of the Pennsylvania Air Brake Company are said to be connected with the Jessup Steel Company.

The S. M. York Machinery Company, Cleveland, O., announces that in order to more thoroughly identify the business with that of the W. M. Pattison Supply Company, with which the concern has always been closely affiliated, it has changed its corporate name to the W. M. Pattison Machinery Company. Aside from this change in name, the business will be conducted as heretofore under the same management at 263 Saint Clair street.

A concern proposes to locate in Tonawanda, N. Y., to manufacture a new kind of belting, to be known as steel rope cordage, made from steel fibers and hemp cord. Henry Rider, formerly of Boston, Mass., is the patentee. The company will erect four buildings at once, and three more in the near future. The industry will employ about 200 men. The company's president will be W. Patterson, of Pittsburg, Pa.; secretary, R. Palmer, of Buffalo.

Edward Harrington, Son & Co., Incorporated, Philadelphia, have had plans completed for a foundry building and factory on a tract between Sixteenth, Seventeenth, Callowhill and Carlton streets, recently purchased. The plot is 100x395 feet. The building will be four stories, 100x200 feet. The present buildings of the company at Fifteenth street and the Reading Subway have been sold, it is said, for an addition to the Baldwin Locomotive Works.

There is a rumor that the Canadian Coal & Steel Company, lately organized at Montreal, will locate at Sydney instead of at Anticosti, as originally planned. This company owns iron ore deposits on the Labrador coast, and is now, it is said, negotiating for the purchase of some of the collieries in Cape Breton. It is further stated that A. J. Moxham will be manager. There is also a report that a large new steel manufacturing concern proposes to locate at Parrsboro, in Cumberland County, N. S., on the Bay of Fundy.

Pawling & Harnischfeger, crane and hoist builders, Milwaukee, Wis., expect eventually to move from their present location to a new site just purchased, on National and Thirty-eighth avenues. It contains 19 1-3 acres, having a north and south frontage of 2,800 feet and possessing excellent shipping facilities. Work will at once commence on the new plant. Their plans at present are simply to increase their output by the additional buildings, though it is the intention in time to transfer their entire works to the new location.

The Jenison Iron & Engineering Works has been formed with a capitalization of $90,000, to manufacture patented specialties and machinery. The officers are I. Preston Rice, chairman; F. C. Marshall, vice-chairman and treasurer, and Robert T. Cooper, secretary. The plant will be at Jenison, Mich., where it has secured a building and equipped it with machinery. The special articles which will be produced include a patent wood split pulley, an electric headlight for locomotives, a dovetailing machine in several different sizes and a hacksaw.

The Minnesota Iron & Construction Company is the name of a Bemidji, Minn., organization, in which M. G. Slocum is at the head, and which will engage in the jobbing of structural and architectural steel, wrought and cast iron work. The company will also deal in machinery, engines and boilers, jail and prison steel cells, steel store fronts, roofing and all kinds of iron work pertaining to building. It is the intention of the company to build a foundry during the summer and commence the manufacture of a number of the articles enumerated above.

A new manufacturing concern will soon be located in Buffalo, N. Y. It is known as the Chemicide Company of America, and is capitalized at $1,000,000. The directors are James Chalmers, Nye E. Farnham, Charles S. Goodfellow and Charles E. Chalmers, all of Buffalo. The company will manufacture a substitute for wood as a material for building, structural work and as interior decoration. Its product is described as a preparation which will have a density half again as great as wood, a weight 25 per cent. less than wood and a strength five times as great. It will also be fireproof. It is manufactured from rubbish (not garbage), sawdust, shavings, etc.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Grant. Gears. See upper corner, page 120.

Casper cat. free. E. G. Smith, Columbia, Pa.

See the Lowe test indicator, page 116.

Punches & dies. Wal.M.Wks.,Waltham,Mass.

Patterns.—Cincinnati Pat. Wks., Cincin., O.

Stamping Dies. Emmons Collins, Chicago.

Dies and Diemaking, 100 pages $1.00, post paid. J. L. Lucas, Bridgeport, Conn.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Working drawings for special machinery. Geo. M. Mayer, M. E., Monadnock, Chicago.

Automatic machinery designed and constructed by the Wellman Sole Cutting Machine Co., Medford, Mass.

Expert designing; industrial machinery; cost account systems installed and maintained. F. W. Brady, Englewood, N. J.

Wanted—Competent managers, superintendents and foremen. James Brady, Room J, 20th Floor, 220 Broadway, New York.

Machinists, send 5 cents in stamps for blueprint table U. S. S. steam, gas and water pipe, giving tapping sizes. E. E. Meyer, Allegheny, Pa.

Wanted—Short contributions by practical power plant engineers for a publication for steam engineers; illustrated when possible. Technical Publishing Co., Burns Bldg., Detroit, Mich.

For Sale.

A new drill drift; always ready; self-contained; quick acting; no hammer needed; low price. Maria Stein Mch. Wks., Maria Stein, O.

For Sale—A bargain; lathe tool for backing off milling cutters and patent on same, with complete set of jigs and tools. G. C. Henning, 220 Broadway, New York.

For Sale—Branch of machine tool line, well established 9 years, with domestic and foreign agencies, separate catalogs, etc., in machine tool center of the West; object, specializing. Address "Chance," care AMER. MACHINIST.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. State mentioned indicates present address of advertiser.

Situations Wanted.

CANADA.

Bradley hammerman; understands machine thoroughly; mechanical graduate. Address, stating work and wages, Box 114, AM. MACH.

CONNECTICUT.

Young technical graduate with experience on general machinery, tools, fixtures, gages and automobiles, desires position on automobiles, gas or steam engines or air compressors. Box 118, AMERICAN MACHINIST.

NEW JERSEY.

Mechanical engineer; experience in running, erecting and building engines; boilers, electric generators and cranes; can furnish good reference. Box 117, AMER. MACHINIST.

NEW YORK.

Machine designer, etc., wants position. Address Box 63, AMERICAN MACHINIST.

Wanted—Position as cost accountant; experienced and well recommended. Box 110, AMERICAN MACHINIST.

Four years' experience as draftsman, also estimator and bidder on iron and steel. Box 119, AMERICAN MACHINIST.

Draftsman, technical education, European, 2 years here, 5 years' shop experience, wants position. Box 115, AMERICAN MACHINIST.

Mechanical engineer (German), transmissions, textile machines, good draftsman, desires position. Box 120, AMER. MACHINIST.

Electrician, polytechnical college graduate, with good experience from drawing and testing room, wants position. Box 126, AM. M.

Electrical engineer, college graduate, 4 years' experience in drawing and testing department, wants position. Box 127, AM. MACH.

Position wanted by an electrical engineer, technical graduate, with thorough experience in drawing and testing work. Box 112, A. M.

Electrical draftsman, technical graduate, 4 years' experience in drawing and testing department, desires position. Box 108, AM. M.

Salesman, well acquainted and capable of filling any representative position; references of highest order. Box 116, AMERICAN MACHINIST.

Salesman, speaking five languages, acquainted with entire Europe, wants connection with firm seeking foreign trade. Arnold, 7 Monroe Place, Brooklyn, N. Y.

Young Norwegian college graduate (Germany), specialty paper machinery, wants to change his position. Address "Paper," care AMERICAN MACHINIST.

Mechanical draftsman, technical graduate, with good experience in general machinery, shop and drafting room, wants position. Box 109, AMERICAN MACHINIST.

A young man, 27 years, with technical education, a practical mechanic and draftsman, desires position. Address Berthold Schwartz, 255 Himrod st., Brooklyn, N. Y.

General foreman, responsible man, up-to-date mechanic, experienced in high-class automatic and interchangeable machinery, is open for engagement. Box 128, AMER. MACH.

Electrical and mechanical engineer, technical graduate, with several years' experience in drawing and testing departments, wants position. Box 113, AMERICAN MACHINIST.

Foreman of machine and tool department employing 40 men desires change; thoroughly experienced in handling men on small and medium work; would locate in any part of country with wide-awake firm; age 32; married; references. Box 121, AMER. MACH.

Position as superintendent of shop manufacturing light interchangeable machinery, who is a thorough, up-to-date mechanic, and can give best results in this line; I am at present engaged, but wish to make a change. Address Box 122, AMERICAN MACHINIST.

PENNSYLVANIA.

Experienced designer of machine tools and special machinery, machinist, technically educated, desires situation in New York city or Philadelphia. Box 104, AMER. MACHINIST.

Help Wanted.

CANADA.

Wanted—First-class mechanic as speed boss; one who is thoroughly familiar with the capacity and the rate of speed at which all kinds of machine tools should run and the maximum cut they could take; must be thoroughly posted on modern and up-to-date methods. Apply to Canadian General Electric Company, Limited, Peterborough, Canada.

Wanted—Foundry foreman for shop in Canada, manufacturing air compressors and hoisting engines, large and small work; must be familiar with up-to-date foundry practice, molding machines, etc.; capable of devising cost-reducing methods of production; shop new and equipped in a thoroughly modern manner; an excellent opening for a capable man; state experience and terms. Box 86, AMERICAN MACHINIST.

CONNECTICUT.

Wanted—A first-class metal pattern maker, one familiar with small patterns. Box 124, AMERICAN MACHINIST.

ILLINOIS.

Wanted—Superintendent and an assistant superintendent in works employing several thousand men, located near Chicago, manufacturing heavy machinery. Address, with references and full information, Lock Box No. 1065, Chicago, Ill.

Wanted—First-class tool designer; must be familiar with modern manufacturing methods; capable of designing jigs and fixtures for small interchangeable work, and should be familiar with compound die work; large (Chicago) manufacturing company. Box 125, AMERICAN MACHINIST.

MARYLAND.

Wanted—Several good, all-around machinists on new and repair work; state age, experience and wages expected. Merwin McKaig, Cumberland, Md.

MASSACHUSETTS.

Wanted—General machinist; one used to milling machine and gear cutting preferred. Boston Gear Works, Boston, Mass.

Wanted—A sober, industrious man, married preferred, with experience on Potter & Johnston or Gisholt lathes. Box 88, AM. M.

Competent foreman is wanted for shop running 15 to 20 men building grinding machinery; write fully as to age, experience and wages expected. "Grinding," care AM. MACH.

Wanted—Several first-class, all-round machinists and toolmakers, in modern, well-equipped factory, on small, automatic machines, tools and fixtures (in Massachusetts); state age, experience and wages expected. Box 66, AMERICAN MACHINIST.

Wanted—Shop agents everywhere to introduce a line of high-class machinists' tools, indispensable to every mechanic; an easy way for the right person to make money; full particulars on application. Massachusetts Tool Co., Greenfield, Mass.

NEW HAMPSHIRE.

Lathe, planer and erecting floor men; give experience and references. Box 123, AM. M.

NEW JERSEY.

Wanted—First-class patternmakers. Apply to the Reeves Engine Co., Trenton, N. J.

Wanted—First-class machinists, in city near Philadelphia; steady work and good pay. The Reeves Engine Co., Trenton, N. J.

Wanted—Lathe and planer hands for night work on heavy machine tool work; good wages to good men. Apply to The Pond Machine Tool Company, Plainfield, N. J.

NEW YORK.

Student desires instruction in designing, gas engines, machine tools and electrical work. Address Box 72, AMER. MACHINIST.

Wanted—Young man with technical education, capable of filling position paying $1,200 to $1,500 per year, as assistant superintendent of manufacturing plant. Write, with full particulars, to Box 130, AM. MACH.

Foreman, energetic, executive ability handling milling and screw machine, lathe and planer work, medium class, in modern fireproof factory; state experience, wages expected and references. Address "Up-to-date," care AMERICAN MACHINIST.

Wanted—Superintendent on heavy machinery; shop located in large Eastern seaboard city, and has up-to-date facilities, employing 500 hands; work varies widely; applicant must have broad experience, executive and mechanical ability and satisfactory reference; to the right man permanent employment and liberal salary. Address, in confidence, James Brady, Room J, 20th Floor, 220 Broadway, N. Y.

OHIO.

Structural and rolling mill draftsmen. Cleve. Engr. Agency, Sta. B, Cleveland, O.

Wanted—Assistant superintendent in factory employing 400 men; must be familiar with modern shop practice and methods and capable of handling men; state age, experience, references and salary required. Address The Ohio Brass Co., Mansfield, O.

Wanted—An experienced designer, by a concern going into the manufacture of forging machinery and bolt and nut machines for their own use; state where employed, give references, age and pay expected. Address reply to "Bolt & Nut," care AMER. MACH.

Wanted—A thoroughly experienced and competent superintendent for locomotive works in all its branches; must be familiar with modern methods, know how to handle men and machinery and capable of obtaining very best results. Address, with age, references, history of self and salary expected, "Locomotive Works," care AMER. MACH.

PENNSYLVANIA.

First-class machine tool salesman, familiar with all standard metal working tools. Apply to Mr. Albert G. Lea, The J. R. Vandyck Co., The Bourse, Philadelphia, Pa.

Wanted—Machinists for outside erection work on gas engines; those with experience preferred; state experience and wages expected. Pierce-Crouch Engine Co., New Brighton, Pa.

Wanted—Agent to sell steel castings on salary or commission; past experience in this line preferred; reply, giving experience, salary or commission required and other necessary information. Box 129, AMER. MACH.

We are constantly increasing the scope of our work, and invite application for positions from first-class patternmakers, molders and machinists; we always have vacancies. Address The Westinghouse Machine Company, East Pittsburgh, Pa.

Wanted—Competent shop superintendent having experience as designer and draftsman, to take charge of an up-to-date foundry and machine shop, just about completed; will employ later 200 mechanics, building hoisting and haulage engines, air compressors, mine ventilating fans, Corliss engines and other machinery for in and around coal mines; must be a systematic, orderly, energetic and successful handler of men; to a thoroughly competent man a good permanent position is offered. Address, stating age, experience in full and reference, to Box 97, AMERICAN MACHINIST.

VERMONT.

Wanted—Screw machine operators; state age, wages expected and references. Box 105, AMERICAN MACHINIST.

Wanted—An experienced, capable man to start automatic screw machines; give full particulars as to experience. Box 54, AM. MACH.

Foreman for general machine shop; specialty, paper making machinery. Address, stating experience, with whom, length of same and lowest wages, Box 111, AMER. MACH.

WEST OF MISSISSIPPI.

Wanted—A machinist who thoroughly understands turret lathes. Box 84, AM. MACH.

WISCONSIN.

Wanted—Competent machine and bench hands. The Kempsmith Mfg. Co., Milwaukee, Wis.

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National Engine Co., Rockford, Ill.
New Era Iron Wks., Dayton, O.
Olds Motor Wks., Lansing, Mich.
Regal Gasoline Engine Co., Coldwater, Mich.
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Struthers-Wells Co., Warren, Pa.

Engines, Steam
Amer. Blower Co., Detroit, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Chandler & Taylor Co., Indianapolis, Ind.
Frick Co., Waynesboro, Pa.
Rand Drill Co., New York.
Struthers-Wells Co., Warren, Pa.

Engraving Machinery
Field, Chas. H., Providence, R. I.

Exhaust Fans
Amer. Blower Co., Detroit, Mich.
Buffalo Forge Co., Buffalo, N. Y.

Factory Sites
Cincinnati Industrial Bureau, Cincinnati, O.

Fans, Electric
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Feed Water Heater and Purifier
Hawley Down Draft Furnace Co., Chicago, Ill.

Files and Rasps
Barnett Co., G. & H., Phila., Pa.
Hammacher, Schlemmer & Co., New York.
Montgomery & Co., New York.
Nicholson File Co., Provi., R. I.
Patterson, Gottfried & Hunter, Ltd., New York.

Filing Machines
Cochrane-Bly Mach. Co., Rochester, N. Y.

Fillers, Oil Can
The Winkley Co., Hartford, Conn.

Fittings, Steam
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Jenkins Bros., New York.
Lunkenheimer Co., Cincinnati, O.
Walworth Mfg. Co., Boston, Mass.

Flexible Shafts
Chicago Flexible Shaft Co., Chicago, Ill.
Stow Mfg. Co., Binghamton, N. Y.

Forges
Buffalo Forge Co., Buffalo, N. Y.
Patterson, Gottfried & Hunter, Ltd., New York.

Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
Hay-Budden Mfg. Co., Brooklyn, N. Y.
Westmoreland Steel Co., Pittsburg, Pa.
Wyman & Gordon, Worcester, Mass.

Foundry Furnishings
Byram & Co., Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Philadel., Pa.
Smith Fdry. Supply Co., J. D., Cleveland, O.
Whiting Foundry Equip. Co., Harvey, Ill.

Furnaces, Coal and Oil
Buffalo Forge Co., Buffalo, N. Y.
Hawley Down Draft Furnace Co., Chicago, Ill.
Jacobson Mach. Mfg. Co., Warren, Pa.
Obermayer Co., S., Cincinnati, O.

Furnaces, Gas
Am. Gas Furnace Co., N. Y. City.
Chicago Flexible Shaft Co., Chicago, Ill.
Westmacott Co., J. M., Prov., R. I.

Furniture, Machine Shop
New Britain Mach. Co., New Britain, Conn.

Gages, Recording
Bristol Co., Waterbury, Conn.

Gages, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gages, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Gear Cutting Machinery
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bultman & Co., F. W., Cleveland, Ohio.
Dwight Slate Mach. Co., Hartford, Conn.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Newton Mch. Tool Wks., Phil., Pa.
Niles Tool Works Co., New York.
Walcott & Son, Geo. D., Jackson, Mich.
Whiton Machine Co., D. E., New London, Conn.

Gears, Cut
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Works, Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bultman & Co., F. W., Cleveland, Ohio.
Fawcus Mach. Co., Pittsburgh, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott, Cleveland, O.
Messmer Mfg. Co., Ferd., St. Louis, Mo.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Philadelphia Gear Works, Philadelphia, Pa.
Sawyer Gear Wks., Cleveland, O.
Simonds Mfg. Co., Pittsburgh, Pa.
Walcott & Son, Geo. D., Jackson, Mich.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cincin., O.

Gears, Rawhide
Chicago Raw Hide Co., Chicago, Ill.
Fawcus Mch. Co., Pittsburgh, Pa.
Horsburgh & Scott, Cleveland, O.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Fawcus Mach. Co., Pittsburgh, Pa.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburgh, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. J.
Lubriphite Co., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Center
Heald & Son, L. S., Barre, Mass.
Hisey-Wolf Mach. Co., Cincin., O.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter
Adams Co., Dubuque, Iowa.
Automatic Mach. Co., Greenfield, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Machine Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.
Woodward & Rogers Co., Hartford, Conn.

Grinders, Disc
Besly & Co., Chas. H., Chicago, Ill.
Gorton Mach. Co., Geo., Racine, Wis.
Iroquois Mach. Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.

Grinders, Drill
Gorton Mach. Co., Geo., Racine, Wis.
Heald & Son, L. S., Barre, Mass.
Standard Tool Co., Cleveland, O.
Washburn Shops, Worcester, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Tool
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Barr, H. G., Worcester, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Diamond Mach. Co., Provi., R. I.
Gisholt Mach. Co., Madison, Wis.
Landis Tool Co., Waynesboro, Pa.
Modern Tool Co., Erie, Pa.
Northampton Emery Wheel Co., Leeds, Mass.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, O.
Throop Perforating Co., Buffalo, N. Y.
Whitney Mfg. Co., Hartford, Ct.

Grinding Machines
Blount & Co., J. G., Everett, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Fairbanks Co., New York.
Falkenau-Sinclair Co., Phila., Pa.
Goodell-Pratt Co., Greenfield, Mass.
Gorton Mach. Co., Geo., Racine, Wis.
Greenfield Mach. Co., Greenfield Mass.
Hill, Clarke & Co., Boston, Mass.
Hisey-Wolf Mch. Co., Cincin., O.
Iroquois Mach. Co., New York.
Landis Tool Co., Waynesboro, Pa.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Mechanical Appliance Co., Milwaukee, Wis.

Grinding Machines—*Cont'd*
Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.
Norton Grinding Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Robertson Mfg. Co., Buffalo, N. Y.
Safety Emery Wheel Co., Springfield, Ohio.
Throop Perforating Co., Buffalo, N. Y.
Vitrified Wheel Co., Westfield, Mass.
Washburn Shops, Worcester, Mass.
Webster & Perks Tool Co., Springfield, O.
Wilmarth & Morman Co., Grand Rapids, Mich.
Woodward & Rogers Co., Hartford, Conn.

Grinding Wheels
Builders' Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Diamond Mach. Co., Provi., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
Montgomery & Co., New York.
Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Vitrified Wheel Co., Westfield, Mass.
Whitney Mfg. Co., Hartford, Conn.

Grindstones and Frames
Cleveland Stone Co., Cleveland, O.
Standard Tool Co., Athol, Mass.

Gun Barrel Machinery
Bement, Miles & Co., New York.
Diamond Mach. Co., Provi., R. I.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Reed Co., F. E., Worcester, Mass.

Hack Saw Blades and Frames
Diamond Saw & Stamping Wks., Buffalo, N. Y.
Goodell-Pratt Co., Greenfield, Mass.
Hammacher, Schlemmer & Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Starrett Co., L. S., Athol, Mass.
West Haven Mfg. Co., New Haven, Conn.

Hack Saws, Power
Diamond Saw & Stamping Wks., Buffalo, N. Y.
Hoefer Mfg. Co., Freeport, Ill.
Olmsted, L. H., Hasbrouck Heights, N. J.
Resek Mach. Tool Co., Cleveland, Ohio.
Robertson Mfg. Co., Buffalo, N. Y.
West Haven Mfg. Co., New Haven, Conn.

Hammers, Drop
Bement, Miles & Co., New York.
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Merrill Bros., Brooklyn, N. Y.
Mossberg & Granville Mfg. Co., Providence, R. I.
Perkins Mach. Co., Boston, Mass.
Williams, White & Co., Moline, Ill.

Hammers, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Dallett & Co., Thos. H., Phila., Pa.
Phila. Pneu. Tool Co., Philadelphia, Pa.
Railway Appliances Co., Chicago, Ill.
Rand Drill Co., New York.
Standard Ry. Equip. Co., St. Louis, Mo.

Hammers, Power
Scranton & Co., The, New Haven, Conn.

Hammers, Steam
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Chambersburg Engr. Co., Chambersburg, Pa.
Cleveland Punch & Shear Wks. Co., Cleveland, O.

Handles, Machine Tool
Norwood Mach. Mfg. Co., Cin., O.

Heating and Ventilating Apparatus
Amer. Blower Co., Detroit, Mich.
Buffalo Forge Co., Buffalo, N. Y.

Heating Machines, Automatic
Am. Gas Furnace Co., New York.

Hoisting and Conveying Machinery
Brown Hoisting Mchry. Co., New York.
Caldwell & Son Co., H. W., Chicago, Ill.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

Hoists, Electric
C & C Electric Co., New York.
Hunt Co., C. W., West New Brighton, N. Y.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger, Milwaukee, Wis.
Sprague Electric Co., New York.

Hoists, Hand
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Northern Engineering Wks., Detroit, Mich.
Rand Drill Co., New York.

Hose Coupler
Clark Co., W. J., Salem, O.

Igniters, Gas Engine
Dayton Electrical Mfg. Co., Dayton, O.

Indicators, Speed
Starrett Co., L. S., Athol, Mass.

Indicators, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Injectors
Lunkenheimer Co., Cincinnati, O.
Rue Mfg. Co., Philadelphia, Pa.
Sellers & Co., Wm., Phila., Pa.

Inspection and Tests
Hunt Co., Robt. W., Chicago, Ill.

Instruction Schools
See Schools, Correspondence.

Insurance, Boiler
Hartford Steam Boiler Insp. & Ins. Co., Hartford, Conn.

Iron Filler
U. S. Gutta Percha Paint Co., Providence, R. I.

Jacks, Hydraulic
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Jack Planer
Armstrong Bros. Tool Co., Chicago, Ill.

Key Seaters
Baker Bros., Toledo, O.
Bement, Miles & Co., New York.
Burr & Son, John T., Brooklyn, N. Y.
Chattanooga Mchry. Co., Chattanooga, Tenn.
Davis Mach. Co., W. P., Rochester, N. Y.
Hill Tool Co., Anderson, Ind.
Metts & Merrill, Saginaw, Mich.
Whitney Mfg. Co., Hartford, Conn.

Keys, Machine
Standard Gauge Steel Co., Beaver Falls, Pa.
Whitney Mfg. Co., Hartford, Ct.

Lamps, Arc
General Electric Co., N. Y. City.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Lathe Attachments
National Machine Tool Co., Cincinnati, O.

Lathe Dogs
Armstrong Bros. Tool Co., Chicago, Ill.
Besly & Co., Chas. H., Chicago, Ill.
Hill Tool Co., Anderson, Ind.
Le Count, Wm. G., So. Norwalk, Conn.
Montgomery & Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Tindel-Morris Co., Eddystone, Pa.

Lathes
American Tool Wks. Co., Cin., O.
Automatic Mach. Co., Greenfield, Mass.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bement, Miles & Co., New York.
Blount & Co., J. G., Everett, Mass.
Bradford Mach. Tool Co., Cin., O.
Bullard Mach. Tool Co., Bridgeport, Conn.
Davis Mach. Co., W. P., Rochester, N. Y.
Diamond Machine Co., Prov., R. I.
Draper Mach. Tool Co., Worcester, Mass.
Fairbanks Co., New York.
Falkenau-Sinclair Co., Phila., Pa.
Fay & Scott, Dexter, Me.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Greaves, Klusman Co., Cincin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mch. Tool Co., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Milwaukee Machine Tool Co., Milwaukee, Wis.
Montgomery & Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Reed Co., F. E., Worcester, Mass.
Schumacher & Boye, Cincinnati, Ohio.
Sebastian Lathe Co., Cincin., O.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Shepard Lathe Co., Cincinnati, O.
Walcott & Son, Geo. D., Jackson, Mich.
Washburn Shops, Worcester, Mass.

Lathes, Automatic Screw-Threading
Automatic Machine Co., Bridgeport, Conn.

Lathes, Bench
Faneuil Watch Tool Co., Boston, Mass.
Fenn-Sadler Mach. Co., Hartford, Conn.
Hardinge Bros., Chicago, Ill.
Loop-Lock Mach. Co., Waltham, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Lathes, Boring
Streit Mach. Co., A., Cincin., O.

Lathes, Hand
Burr & Son, John T., Brooklyn, N. Y.

Lathes, Wood
Amer. Mchry. Co., Grand Rapids, Mich.

Letters, Pattern
Brim, A. W., Seneca Falls, N. Y.
Butler, A. G., N. Y. City.

Levels
Mass. Tool Co., Greenfield, Mass.
Starrett Co., L. S., Athol, Mass.

Lockers, Clothes
Merritt & Co., Philadelphia, Pa.
Narragansett Mach. Co., Providence, R. I.

Locomotives, Shop
Hunt Co., C. W., West New Brighton, N. Y.

Lubricants
Besly & Co., Chas. H., Chicago, Ill.
Dixon Crucible Co., Jos., Jersey City, N. J.
Lubriphite Co., Jersey City, N. J.

Lubricators
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lubriphite Co., Jersey City, N. J.
Lunkenheimer Co., Cincinnati, O.

Machine Screws
Atlantic Mach. Screw Co., Boston, Mass.
Worcester Mach. Screw Co., Worcester, Mass.

Machinery Builders, Special
American Fdry. & Mach. Co., Hanover, Pa.
Blanchard Mach. Co., The, Boston, Mass.
Eclipse Mach. Co., Cleveland, O.
Fawcus Mch. Co., Pittsburgh, Pa.
Hart, Frederick, Poughkeepsie, N. Y.
Hoefer Mfg. Co., Freeport, Ill.
Power & Speed Regulator & Mfg. Co., Kalamazoo, Mich.
Pratt & Whitney Co., Hartford, Conn.
Rhodes, L. E., Hartford, Conn.
Simonds Mfg. Co., Pittsburgh, Pa.
Williams Tool Co., Erie, Pa.
Woodward & Rogers Co., Hartford, Conn.

Machinists' Small Tools
Besly & Co., Chas. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
Lowe, H. A., Waltham, Mass.
McCrosky & Huber, Cincinnati, O.
Mass. Tool Co., Greenfield, Mass.
Montgomery & Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Rayl Co., T. B., Detroit, Mich.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Provi., R. I.
Smith, E. G., Columbia, Pa.
Standard Tool Co., Cleveland, O.
Standard Tool Co., Athol, Mass.
Starrett Co., L. S., Athol, Mass.
Wyke & Co., J., E. Boston, Mass.

Machinists' Supplies
Hammacher, Schlemmer & Co., New York.
Montgomery & Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Rayl Co., T. B., Detroit, Mich.

Mandrels, Expanding
Nicholson & Son, W. H., Wilkesbarre, Pa.

Mandrels, Solid
Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Measuring Machines
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.

Metal, Bearing
Besly & Co., Chas. H., Chicago, Ill.
Patterson, Gottfried & Hunter, Ltd., New York.
Spence Mfg. Co., Milwaukee, Wis.

Metal, Perforated
Throop Perforating Co., Buffalo, N. Y.

Micrometer Calipers
Brown & Sharpe Mfg. Co., Providence, R. I.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.
Syracuse Twist Drill Co., Syracuse, N. Y.

Milling Attachments
The Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.

Milling Attachments—*Cont'd*
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Kempsmith Mfg. Co., Milwaukee, Wis.
Whitney Mfg. Co., Hartford, Conn.

Milling Machines, Bench
Faneuil Watch Tool Co., Boston, Mass.
Hill, Clarke & Co., Boston, Mass.
Loop-Lock Mach. Co., Waltham, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Horizontal
Adams Co., Dubuque, Iowa.
Beaman & Smith Co., Prov., R. I.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bement, Miles & Co., New York.
Hendey Mach. Co., Torrington, Ct.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Milling Machines, Plain
American Tool Wks. Co., Cin., O.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Fairbanks Co., New York.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Marshall & Huschart Mchry. Co., Chicago, Ill.
McCabe, J. J., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Portable
Underwood & Co., H. B., Philadelphia, Pa.

Milling Machines, Universal
American Tool Wks. Co., Cin., O.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Fairbanks Co., New York.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Marshall & Huschart Mchry. Co., Chicago, Ill.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Vertical
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Garvin Mach. Co., New York.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mch. Tool Works, Philadelphia, Pa.
Niles Tool Works Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Pratt & Whitney Co., Hartford, Conn.
Quint, A. D., Hartford, Conn.

Milling Tools, Adjustable
Geometric Drill Co., New Haven, Conn.
Rogers, Boat, Gage & Drill Wks., John M., Gloucester City, N. J.

Molds, Hammer and Vise Jaw
Field, Chas. H., Providence, R. I.

Molding Machines
Adams Co., The, Dubuque, Iowa.
American Foundry & Mach. Co., Hanover, Pa.
Tabor Mfg. Co., Philadelphia, Pa.
Webster & Perks Tool Co., Springfield, O.

Motors, Electric
Akron Elec. Mfg. Co., Akron, O.
C & C Electric Co., New York.
Christensen Engr. Co., Milwaukee, Wis.
Commercial Electric Co., Indianapolis, Ind.
Crocker-Wheeler Co., Ampere, N.J.
Cutler-Hammer Mfg. Co., Milwaukee, Wis.
Eck Dynamo & Motor Wks., Belleville, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Mechanical Appliance Co., Milwaukee, Wis.
Milwaukee Elec. Co., Milwaukee, Wis.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Sprague Electric Co., New York.
Storey Motor & Electric Co., Harrison, N. J.
Stow Mfg. Co., Binghamton, N. Y.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Name Plates
Becker Name Plate Co., August, Boston, Mass.
Franklin Mfg. Co., Syracuse, N. Y.
G. & P. Engraving Co., Boston, Mass.
Murdock Corporation, Boston, Mass.

Nut Tappers
See Bolt and Nut Machinery.

Oil Cups and Covers
Bay State Stamping Works, Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Bown Machine Wks., Battle Creek, Mich.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.
Tucker, W. W. & C. F., Hartford, Conn.
The Winkley Co., Hartford, Conn.

Oils
Besly & Co., Chas. H., Chicago, Ill.
Harris Oil Co., A. W., Provi., R. I.

Oils, Slushing
Harris Oil Co., A. W., Provi., R. I.

Oil Stones
Pike Mfg. Co., Pike Station, N. H.

Packing, Steam Joint
Jenkins Bros., New York.
N. Y. Belting & Packing Co., New York.
Peerless Rubber Mfg. Co., New York.

Paint, Machinery
Felton, Sibley & Co., Phila., Pa.
U. S. Gutta Percha Paint Co., Providence, R. I.

Pans, Lathe
Lyon Metallic Mfg. Co., Chicago, Ill.
New Britain Mch. Co., New Britain, Conn.

Pans, Shop
Kilbourne & Jacobs Mfg. Co., Columbus, O.
Lyon Metallic Mfg. Co., Chicago, Ill.

Patents
Baldwin, Davidson & Wight, Washington, D. C.
Howson & Howson, Philadel., Pa.

Pattern Shop Machinery
Amer. Mchry. Co., Grand Rapids, Mich.
Baker Bros., Toledo, O.
Fairbanks Co., New York.
Fay & Scott, Dexter, Me.
Field, Chas. H., Providence, R. I.
Greaves, Klusman & Co., Cin., O.
Machinery Exchange, Chicago, Ill.
Marston & Co., J. M., Boston, Mass.
Prentiss Tool & Supply Co., New York.
Washburn Shops, Worcester, Mass.

Patterns, Wood
Hartford Pattern & Model Co., Hartford, Conn.
Olmstead Co., H. B., New York.

Pencils
Dixon Crucible Co., Jos., Jersey City, N. J.
Keuffel & Esser Co., New York.

Pinion Cutters
Loop-Lock Mach. Co., Waltham, Mass.

Pipe and Fittings
Crane Co., Chicago, Ill.

Pipe Cutting and Threading Machines
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Curtis & Curtis Co., Bridgeport, Conn.
Merrell Mfg. Co., Toledo, O.
Oster Mfg. Co., Cleveland, O.
Reed Mfg. Co., Erie, Pa.
Saunders' Sons, D., Yonkers, N. Y.
Wells Bros. Co., Greenfield, Mass.
Williams Tool Co., Erie, Pa.

Pipe Fitters' Tools
Cleveland Twist Drill Co., Cleveland, O.
Saunders' Sons, D., Yonkers, N. Y.
Standard Tool Co., Cleveland, O.

Planers
American Tool Wks. Co., Cin., O.
Belmer Mach. Tool Co., Cin., O.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del
Cincinnati Planer Co., Cincin., O.
Detrick & Harvey Mch. Co., Baltimore, Md.
Fairbanks Co., New York.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Gray Co., G. A., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Pond Mach. Tool Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Wm., Phila., Pa.
Whitcomb Mfg. Co., Worcester, Mass.
Woodward & Powell Planer Co., Worcester, Mass.

Planers, Bench
Bartlett, E. E., Boston, Mass.

Planers, Portable
Morton Mfg. Co., Muskegon Heights, Mich.
Underwood & Co., H. B., Philadelphia, Pa.

Planers, Rotary
Bement, Miles & Co., New York.
Cleveland Punch & Shear Works, Cleveland, O.
Newton Mach. Tool Wks., Philadelphia, Pa.
Pond Mach. Tool Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Presses, Hand
Perkins Mach. Co., So. Boston, Mass.

Presses, Hydraulic
Watson-Stillman Co., New York.

Presses, Power
Automatic Mach. Co., Bridgeport, Conn.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Chambersburg Engr. Co., Chambersburg, Pa.
Fairbanks Co., New York.
Falkenau-Sinclair Mch. Co., Philadelphia, Pa.
Mossberg & Granville Mfg. Co., Providence, R. I.
Perkins Mach. Co., So. Boston, Mass.
Prentiss Tool & Supply Co., New York.
Wold & Co., Torris, Chicago, Ill.

Profilers
Garvin Mach. Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Pulleys, Friction Cone
Evans Friction Cone Co., Boston, Mass.

Pulleys
Amer. Pulley Co., Philadel., Pa.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Federal Mfg. Co., Cleveland, O.
Howard Iron Wks., Buffalo, N. Y.
Oneida Steel Pulley Co., Oneida, N. Y.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.
The Xylotite Co., Cincinnati, O.

Pulleys, Speed Changing
Speed Changing Pulley Co., Indianapolis, Ind.

Pulley Turning and Boring Machines
Harrington, Son & Co., Edwin, Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Streit Mach. Co., A., Cincin., O.

Pumps, Hydraulic
Watson-Stillman Co., New York.

Punches, Hydraulic
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Punches, Power
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cincinnati Punch & Shear Co., Cincinnati, O.
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Perkins Mach. Co., S. Boston, Mass.
Reade Mchry. Co., Cleveland, O.
Williams, White & Co., Moline, Ill.

Rack Cutting Machines
Fellows Gear Shaper Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Reed Co., F. E., Worcester, Mass.
Walcott & Son, Geo. D., Jackson, Mich.

Racks, Cut
Fellows Gear Shaper Co., Springfield, Vt.
Nuttall Co., R. D., Pittsburgh, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.
Standard Gauge Steel Co., Beaver Falls, Pa.
Walcott & Son, Geo. D., Jackson, Mich.

Racks, Tool
Lyon Metallic Mfg. Co., Chicago, Ill.
New Britain Mach. Co., New Britain, Conn.

Reamers
Chadwick & Co., J. B., Portsmouth, N. H.
Cleveland Twist Drill Co., Cleveland, O.
Clough, R. M., Tolland, Conn.
McCrosky & Huber, Cincinnati, O.
Montgomery & Co., New York.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
New Process Twist Drill Co., Taunton, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.

Reaming Stands
Flather Planer Co., Mark, Nashua, N. H.

Rheostats
Cutler-Hammer Mfg. Co., Milwaukee, Wis.

Riveters, Pneumatic
Bement, Miles & Co., New York.
Cleveland Pneumatic Tool Co., Cleveland, O.
Philadelphia Pneumatic Tool Co., Philadelphia, Pa.
Railway Appliances Co., Chicago, Ill.
Rand Drill Co., New York.
Standard Ry. Equip. Co., St. Louis, Mo.

Riveters, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Riveting Machines
Bement, Miles & Co., New York.
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Chambersburg Engr. Co., Chambersburg, Pa.
Long & Allstatter Co., Hamilton, Ohio.
Perkins Mach. Co., So. Boston, Mass.

Roller and Ball Bearings
Amer. Roller Bearing Co., Boston, Mass.
Ball Bearing Co., Philadel., Pa.
Bantam Mfg. Co., Bantam, Conn.
Mossberg & Granville Mfg. Co., Providence, R. I.
Standard Roller Bearing Co., Philadelphia, Pa.

Rolling Mill Machinery
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Mossberg & Granville Mfg. Co., Providence, R. I.
Pratt & Whitney Co., Hartford, Conn.

Rubber Goods, Mechanical
N. Y. Belting & Packing Co., New York.
Peerless Rubber Mfg. Co., New York.

Rules, Steel
Mass. Tool Co., Greenfield, Mass.
Sawyer Tool Co., Fitchburg, Mass.
Slocomb Co., J. T., Provi., R. I.
Starrett Co., L. S., Athol, Mass.

Safety Valves, Pop
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.

Sand Blast Apparatus
Paxson Co., J. W., Philadel., Pa.

Sand Mixing Machines
Obermayer Co., S., Cincinnati, O.
Smith Fdry. Supply Co., J. D., Cleveland, O.

Sawing Machines, Metal
Cleveland Punch & Shear Works Co., Cleveland, O.
Cochrane Bly Mach. Works, Rochester, N. Y.
Newton Mach. Tool Works, Philadelphia, Pa.
Pratt & Whitney Co., Hartford, Conn.
Reade Mchry. Co., Cleveland, O.
Resek Mach. Tool Co., Cleveland, Ohio.
West Haven Mfg. Co., New Haven, Conn.

Sawing Machines, Wood
American Machinery Co., Grand Rapids, Mich.
Marston & Co., J. M., Boston, Mass.

Schools, Correspondence
Amer. School of Correspondence, Chicago, Ill.
Consolidated Schools, N. Y. City.
International Correspond. Schools, Scranton, Pa.

Screw Machines, Automatic
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Dreses Mach. Tool Co., Cincin., O.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Windsor Mach. Co., Windsor, Vt.

Screw Machines, Hand
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Draper Mach. Tool Co., Worcester, Mass.
Garvin Mach. Co., New York.
Jones & Lamson Mch. Co., Springfield, Vt.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Screw Machinery, Wood and Lag

Baker Bros., Toledo, Ohio.
Cook Co., Asa S., Hartford, Conn.

Screw Plates

Besly & Co., Chas. H., Chicago, Ill.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Card Mfg. Co., S. W., Mansfield, Mass.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Oster Mfg. Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Second Hand Machinery

Baird Machy. Co., Pittsburg, Pa.
Bowler & Co., Geo. H., Cleveland, Ohio.
Carlin Mchry. & Supply Co., Allegheny, Pa.
Fairbanks Co., New York.
Fairbanks Co., Philadelphia, Pa.
Garvin Mch. Co., New York.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mchry. Co., Chicago, Ill.
McCabe, J. J., New York.
Niles-Bement-Pond Co., New York.
Pattison Machinery Co., W. M., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Toomey, Frank, Philadelphia, Pa.
Wickes Bros., New York.
Wormer Machy. Co., C. C., Detroit, Mich.

Separators, Oil

Amer. Tool & Mach. Co., Boston, Mass.
Springfield Separator Co., Manchester, N. H.

Shapers

American Tool Wks. Co., Cin., O.
Fement, Miles & Co., New York.
Flount & Co., J. G., Everett, Mass.
Cincinnati Shaper Co., Cincin., O.
Fairbanks Co., New York.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Gould & Eberhardt, Newark, N. J.
Hendey Mch. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kelly Co., R. A., Xenia, Ohio.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Morton Mfg. Co., Muskegon Heights, Mich.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Perkins Mach. Co., So. Boston, Mass.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Prentiss Tool & Supply Co., New York.
Steptoe Shaper Co., John, Cincinnati, O.
Walcott & Son, Geo. D., Jackson, Mich.

Shears, Rotary

Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.
Perkins Mach. Co., So. Boston, Mass.

Shears, Power

Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cincinnati Punch & Shear Co., Cincinnati, O.
Cleveland Punch & Shear Works, Cleveland, O.
Falkenau-Sinclair Mach. Co., Philadelphia, Pa.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Perkins Mach. Co., So. Boston, Mass.
Reade Mchry. Co., Cleveland, O.
Williams, White & Co., Moline, Ill.

Shelving, Shop

New Britain Mach. Co., New Britain, Conn.

Slide Rests

Bartlett, E. E., Boston, Mass.
Reed Co., F. E., Worcester, Mass.
Rhodes, L. E., Hartford, Conn.

Slotters

Baker Bros., Toledo, Ohio.
Barr, H. G., Worcester, Mass.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Garvin Mach. Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.

Sockets and Sleeves

New Process Twist Drill Co., Taunton, Mass.

Speed Limit System

Consolidated Engine Stop Co., New York.

Springs

Dunbar Bros., Bristol, Conn.

Sprocket Chains

See Driving Chains.

Stampings, Sheet Steel

Federal Mfg. Co., Cleveland, O.

Stamps, Steel

Schwerdtle Stamp Co., Bridgeport, Conn.

Steel, Machinery

Boker & Co., Hermann, New York.
Patriarche & Bell, New York.
Ward & Son, Edgar T., Boston, Mass.

Steel, Sheet

Federal Mfg. Co., Cleveland, O.
Ward & Son, Edgar T., Boston, Mass.

Steel, Tool

Boker & Co., Hermann, New York.
Firth-Sterling Steel Co., Demmler, Pa.
Patriarche & Bell, New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Westmoreland Steel Co., Pittsburg, Pa.

Stones, Oil

Pike Mfg. Co., Pike Station, N. H.

Straightener, Hydraulic

Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Swaging Machines

Excelsior Needle Co., Torrington, Conn.
Mossberg & Granville Mfg. Co., Providence, R. I.

Switchboards

C & C Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Tapping Machines and Attachments

Baker Bros., Toledo, O.
The Beaman & Smith Co., Providence, R. I.
Bickford Drill & Tool Co., Cin., O.
Cincinnati Mach. Tool Co., Cincinnati, O.
Errington, F. A., N. Y. City.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Geometric Drill Co., New Haven, Conn.
Modern Tool Co., Erie, Pa.
Murray Mfg. Co., Richmond Valley, S. I., N. Y.
Pratt & Whitney Co., Hartford, Conn.
Quint, A. D., Hartford, Conn.
Webster & Perks Tool Co., Springfield, O.
Whitney Mfg. Co., Hartford, Conn.
Woodward & Rogers Co., Hartford, Conn.

Taps, Collapsing

Geometric Drill Co., New Haven, Conn.

Taps and Dies

Besly & Co., Chas. H., Chicago, Ill.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Crane Co., Chicago, Ill.

Taps and Dies—*Continued*

Geometric Drill Co., New Haven, Conn.
Hammacher, Schlemmer & Co., New York.
Hardinge Bros., Chicago, Ill.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Beuford, Mass.
Oster Mfg. Co., Cleveland, O.
Patterson Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.
Webster & Perks Tool Co., Springfield, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Telephone System

Clark Auto. Telephone Switch Board Co., Providence, R. I.

Thread Cutting Tools

Besly & Co., Chas. H., Chicago, Ill.
Hart Mfg. Co., Cleveland, O.
Oster Mfg. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Tongs, Machinery

Acme Tongs Co., Chicago, Ill.

Tool Holders

Armstrong Bros. Tool Co., Chicago, Ill.
Hill Tool Co., Anderson, Ind.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Jaques Bush Mfg. Co., Provi., R. I.
McCrosky & Huber, Cincinnati, O.
Montgomery & Co., New York.
O. K. Tool Holder Co., Shelton, Conn.
Western Mfg. Co., Springfield, O.

Tools, Small

See Machinists' Small Tools.

Tracing Cloth

Hardtmuth, L. & C., New York.

Transmission Machinery

Amer. Pulley Co., Philadel., Pa.
Caldwell & Son Co., H. W., Chicago, Ill.
Case Mfg. Co., Columbus, O.
Cresson & Co., Geo. V., Phila., Pa.
Federal Mfg. Co., Cleveland, O.
Link-Belt Engineering Co., Philadelphia, Pa.
National Machine Tool Co., Cincinnati, O.
Oneida Steel Pulley Co., Oneida, N. Y.
Patterson, Gottfried & Hunter, Ltd., New York.
Power & Speed Regulator Mfg. Co., Kalamazoo, Mich.
Reeves Pulley Co., Columbus, Ind.

Trimmers, Wood

Amer. Machinery Co., Grand Rapids, Mich.
Washburn Shops, Worcester, Mass.

Trolleys and Tramways

Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Maris Bros., Philadelphia, Pa.
Yale & Towne Mfg. Co., New York.

Tubing, Steel

Shelby Steel Tube Co., Pittsburgh, Pa.

Turret Machines

Amer. Tool & Machine Co., Boston, Mass.
Automatic Mach. Co., Greenfield, Mass.
Bradford Mach. Tool Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builard Mach. Tool Co., Bridgeport, Conn.
Dreses Mach. Tool Co., Cincin., O.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Gisholt Mch. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Jones & Lamson Mch. Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.

Turret Machines—*Continued*

Milwaukee Mach. Tool Co., Milwaukee, Wis.
Niles Tool Works Co., New York.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnson Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Turrets, Carriage

Fay & Scott, Dexter, Me.

Twist Drills

Cleveland Twist Drill Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
Morse Twist Drill & M. Co., New Bedford, Mass.
New Process Twist Drill Co., Taunton, Mass.
Patterson, Gottfried & Hunter, Ltd., New York.
Standard Tool Co., Cleveland, O.

Universal Joints

Baush Machine Tool Co., Springfield, Mass.
Vanderbeek Tool Wks., Hartford, Conn.

Valves

See Steam Fittings.

Vises, Drill

Graham Mfg. Co., Provi., R. I.
Hopkinson Mach. Wks., Springfield, Mass.
Jacobson Mach. Mfg. Co., Warren, Pa.

Vises, Metal Workers'

Hammacher, Schlemmer & Co., New York.
Hanna, E. E., Chicago, Ill.
Howard Iron Wks., Buffalo, N. Y.
Jacobson Mach. Mfg. Co., Warren, Pa.
Parker Co., Chas., Meriden, Conn.
Reed Mfg. Co., Erie, Pa.
Standard Tool Co., Athol, Mass.
Walworth Mfg. Co., Boston, Mass.

Vises, Pipe

Curtis & Curtis Co., Bridgeport, Conn.
Saunders' Sons, D., Yonkers, N. Y.
Walworth Mfg. Co., Boston, Mass.

Vises, Planer and Shaper

Cincinnati Planer Co., Cincin., O.
Hendey Mach. Co., Torrington, Ct.
Pratt & Whitney Co., Hartford, Conn.

Vises, Wood Workers'

Emmert Mfg. Co., Waynesboro, Pa.
Gard, J. L., Denver, Colo.
Hammacher, Schlemmer & Co., New York.
Wyman & Gordon, Worcester, Mass.

Welding, Electric

Standard Welding Co., Cleveland, Ohio.

Welding Machines

Long & Allstatter Co., Hamilton, Ohio.

Wire-Drawing Machinery

Iroquois Mach. Co., New York.
Mossberg & Granville Mfg. Co., Providence, R. I.

Wire-Forming Machinery

Automatic Mach. Co., Bridgeport, Conn.

Wire-Straightening Machinery

Hoefer Mfg. Co., Freeport, Ill.

Wood Working Machinery

Amer. Mchry. Co., Grand Rapids, Mich.

Worm Hobbing Machines

Pratt & Whitney Co., Hartford, Conn.

Worm Milling Machines

Cleveland Automatic Mach. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.

Wrenches

Coes Wrench Co., Worcester, Mass.
Standard Tool Co., Athol, Mass.

Wrenches, Drop Forged

Billings & Spencer Co., Hartford, Conn.

Engine Lathe Apron.

The accompanying half-tones illustrate the apron with which the lathes manufactured by the Draper Machine Tool Company, of Worcester, Mass., are fitted. This apron possesses, as will be observed, a number of interesting features; and both the supporting frame-work and the gearing and other mechanism have been designed with a view to securing added rigidity as well as ease of operation.

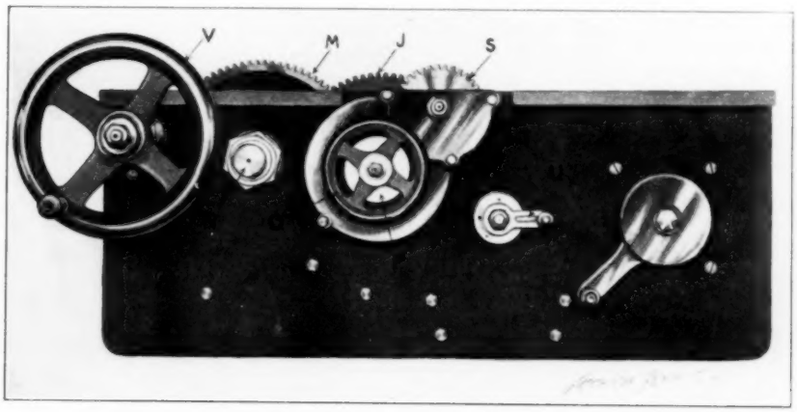


FIG. 1. FRONT VIEW OF APRON.

The arrangement of the mechanism in the apron will be clearly understood from the engravings, Fig. 1 showing a front view, Fig. 2 a rear or inside view, and Fig. 3 a view from the top as the apron would appear when removed from the carriage.

The gearing in this apron is driven by a splined lead-screw, the threads of which are used for screw cutting only. The open-and-shut nut for this screw, which nut is chased from the solid metal before splitting, is shown at *F*, Figs. 2 and 3. The lead screw passes through the pair of bevel pinions *E* supported in brackets *C*. Clutch teeth are formed on the inner end of each pinion; and between the two pinions is placed the clutch *E'*, which is mounted on, and driven by a key in, the splined lead screw. Through the medium of an eccentric—controlled by a handle *U* (Fig. 1) at the front of the apron—and a block in the circumferential groove in *E'* this clutch is shifted laterally, to engage either of the bevel pinions *E*, and thus to drive in either direction the bevel gear *G* with which these pinions are always properly in mesh.

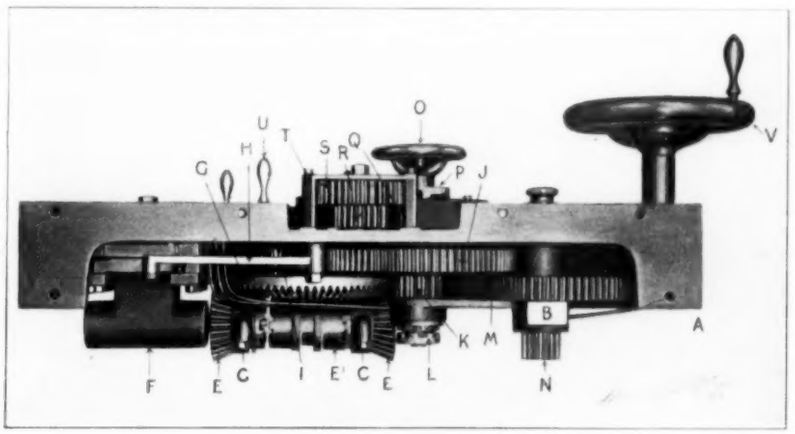


FIG. 3. TOP VIEW OF APRON.

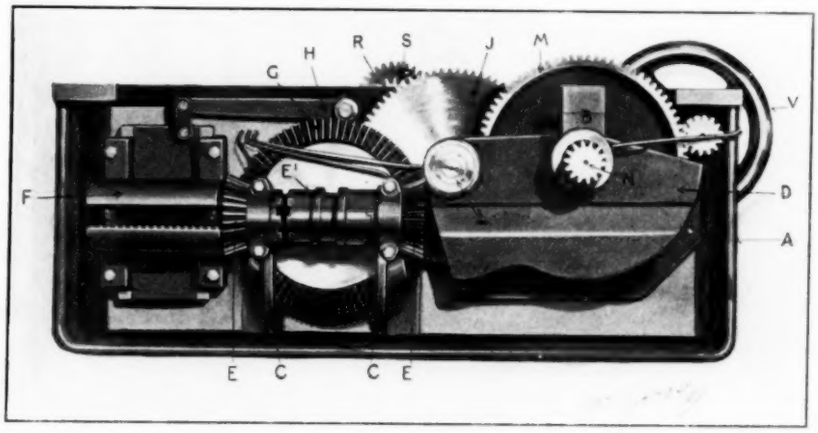


FIG. 2. REAR OR INSIDE VIEW OF APRON.

A pinion *I*, Fig. 3, mounted back of and secured to gear G, is constantly in mesh with the large friction gear *J* (the friction being of the cone type); and, as will be noticed, the face of *I* is much wider than that of *J*. On the inner end of the hub of the friction *J* is fastened a clutch ring *L*, which matches a clutch formed on pinion *K* also mounted on the hub of *J*. Another clutch member *P* is mounted on the gear hub, in front of the apron, and directly behind the hand-wheel *O*; both clutches are shown disengaged. In this position, if the friction in *J* is clamped, no motion will be transmitted to either cross or longitudinal feed.

Attached to the nut *F* by a short link, and fulcrumed near the top of the apron, as shown in Figs. 2 and 3, is a bell crank *H*, the lower end of which is formed with a fork. When the nut is closed on the lead screw, with gear *J* in the position indicated in Fig. 3, the fork of the bell crank will lock the gear in this mid-position, and no feed other than that given by the thread of the screw can be obtained.

To engage the longitudinal feed, the nut *F* must be opened, thus releasing the gear *J*. By pulling on the friction hand wheel *O*, the friction gear—together with its clutches *L* and *P*—is drawn forward until *L* and the clutch formed on *K* are engaged; then, turning *O* to the right, the friction in *J* is engaged, and the motion of the lead screw is transmitted through the clutch *E'* to one of the bevel gears *E*, thence through *G* and its connecting pinion *I* to *J*, through the friction and its clutch *L* to pinion *K*, and then to the large gear *M* and pinion *N* (which are keyed together), the latter engaging the rack. When gear *J* is drawn forward, the fork end of bell crank *H* prevents nut *F* being closed, and as the clutch at *P* which connects the cross-feed train of gears has been still further moved away from its engaging position, only the longitudinal feed can be operative.

To engage the cross-feed the hand wheel *O* is pushed inward, thus disengaging the clutches at *L* and engaging clutch *P* with a clutch member on the hub of the gear *Q*; this gear meshes with the compound gear *R S* at the top of the apron, the larger gear engaging a gear upon the cross-feed screw. The interlocking features of the mechanism will now prevent

the engagement of the longitudinal and screw-cutting feeds. Thus it will be seen that with one feed thrown in it is impossible to engage any other. The rack gear *N* can also be moved outward and away from the rack when the nut *F* is engaged with the lead screw. The large hand wheel *V* with its shaft and pinion—the latter meshing, as shown in Fig. 2, with gear *M*—permits the quick traverse of the carriage along the bed.

The design of the main casting of the apron, the means for oiling the working parts, and the provision made for bolting the apron to the carriage are clearly indicated in the engravings. Working parts which pass through from the front are supported by bushings or quills; and the friction gear *J* and its pinion, also the rack gear *N*, are provided (to prevent springing) with inner bearings in a bracket *D* which is bolted securely to the apron, and also, through the lug *B* above gear *N*, directly to the carriage. The compound gear, which operates the cross-feed screw, is mounted on a stud, supported at each end; in the rear by the apron and at the opposite end by a bracket which also acts as a guard to cover the gearing in front.

A Ship Plate Scarfing Machine.

The accompanying half-tones illustrate a machine for scarfing ship plates which was recently supplied to the Eastern Ship Building Company by the Builders' Iron Foundry.

The operation of scarfing a plate is shown in the diagram, Fig. 1, the surface *a* being cut upon an incline so as to come down to a thin, though not feather edge at *b*. The plates to be scarfed are marked out—the length of the cut being always the same for any thickness of plate—

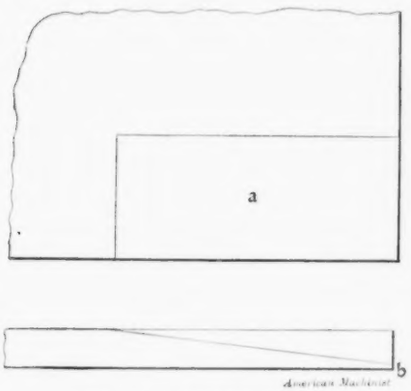


FIG. 1. A SCARFED PLATE.

and the machine being properly adjusted for the thickness of the plate, the proper ending of the cut is assured by the construction of the machine.

Fig. 2 shows the manner in which the scarfed plates are used in a ship's side, the thickness being much exaggerated for clearness. The plates are in horizontal rows, each alternate row projecting beyond the intermediate row by an amount equal to the thickness of the plate. It will be clear from this illustration how the plate *B* is scarfed at the upper and lower right-hand corners, and how by bending plates *B* and *C* the scarfed corners present a flat surface against plate *A*.

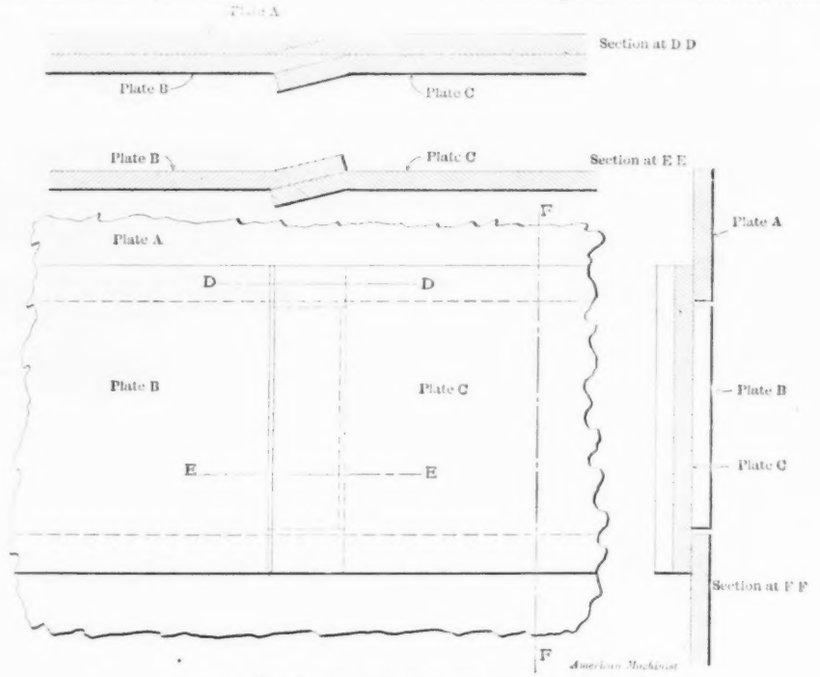


FIG. 2. SCARFED PLATES IN PLACE IN A SHIP'S SIDE.

Figs. 3 and 4 show right and left diagonal front views of the machine, and Fig. 5 shows the cutter head on a larger scale. In the rear of the bed is a plate edge planing tool slide which is used chiefly on the ends of plates in order to relieve the face milling cutter driven by an enclosed oil-flooded worm and wheel at the top of its spindle, the entire spindle head swivels about the worm shaft in order to adjust the cutter at an angle such that its spindle is perpendicular to the surface to

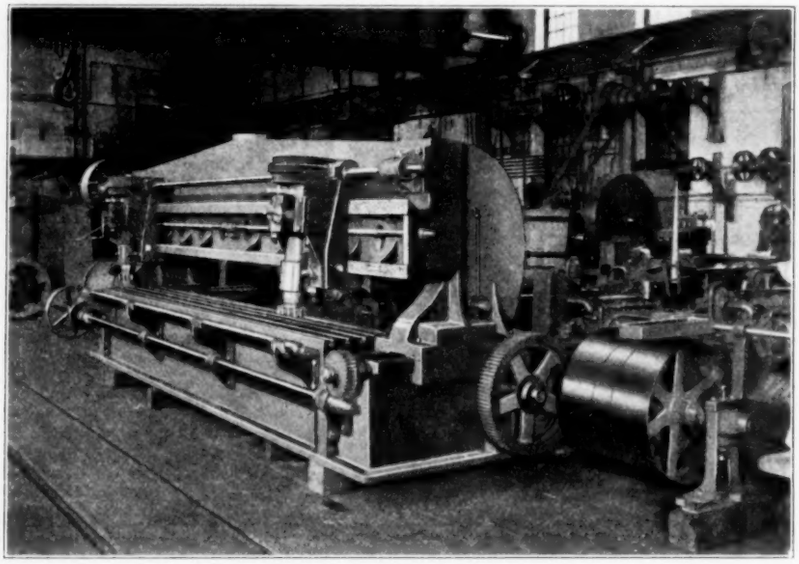


FIG. 3. THE SCARFING MACHINE.

larger planers by taking short work from them. This planing attachment is driven by the pulleys in the foreground of Fig. 3, the scarfing heads being driven by the pulley at the top of the end housing in the foreground of Fig. 4. Inasmuch as scarfing alone would not keep the machine fully occupied, the combination is an entirely legitimate one, but as the novel features relate chiefly to the scarfing function, our description will be confined to that.

The scarfing tool is an inserted tooth

be cut. This adjustment is made quickly and positively by inserting a round pin in the square hole seen near the bottom of the spindle head slide. An assortment of these pins suitable for different thicknesses of plate is provided, the pins being long

enough to reach under the spindle head and project through a corresponding square hole on the opposite side. After the pin is in place, binding bolts, which are clearly shown, bind the head in position.

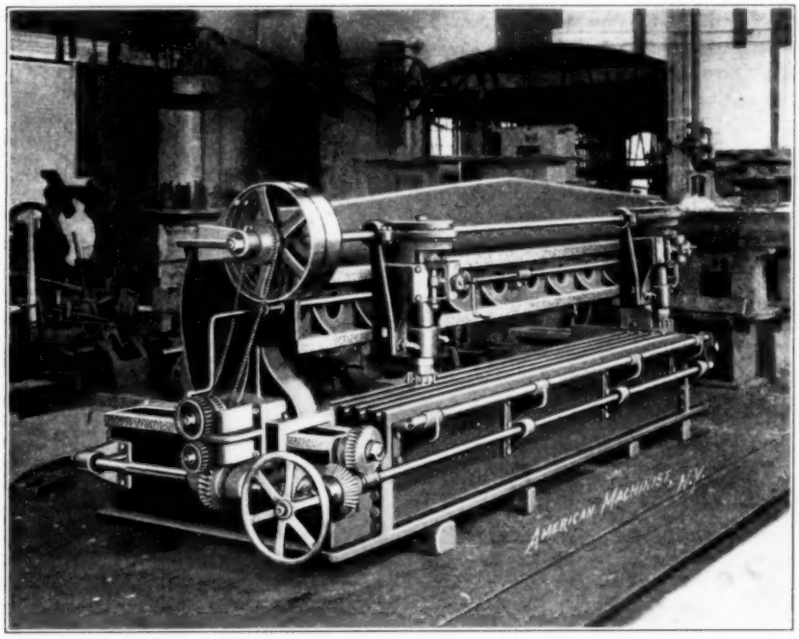


FIG. 4. THE SCARFING MACHINE.

A slow vertical feed is given to the spindle by a train of gears which take their motion directly from it and a hand crank slipped on the square end of the gear shafts provides for initial adjustment of the cut. For the endwise feed of the cut the entire upper structure is fed backward through a screw under the foot of each housing, the screws being driven by worm gears and the shaft in front of the machine, this latter taking its motion from the change gears at the end seen in Fig. 4, a pitch chain drive connecting these gears with the main driving shaft. The long horizontal screw with the crank at its end is for the adjustment of the positions of the cutter heads.

This feed mechanism is the most novel feature of the machine. It will be observed that a diagonal movement of the cutter is obtained by combining a slow endwise movement of the spindle with a faster transverse movement without resorting to adjustable diagonal slideways.

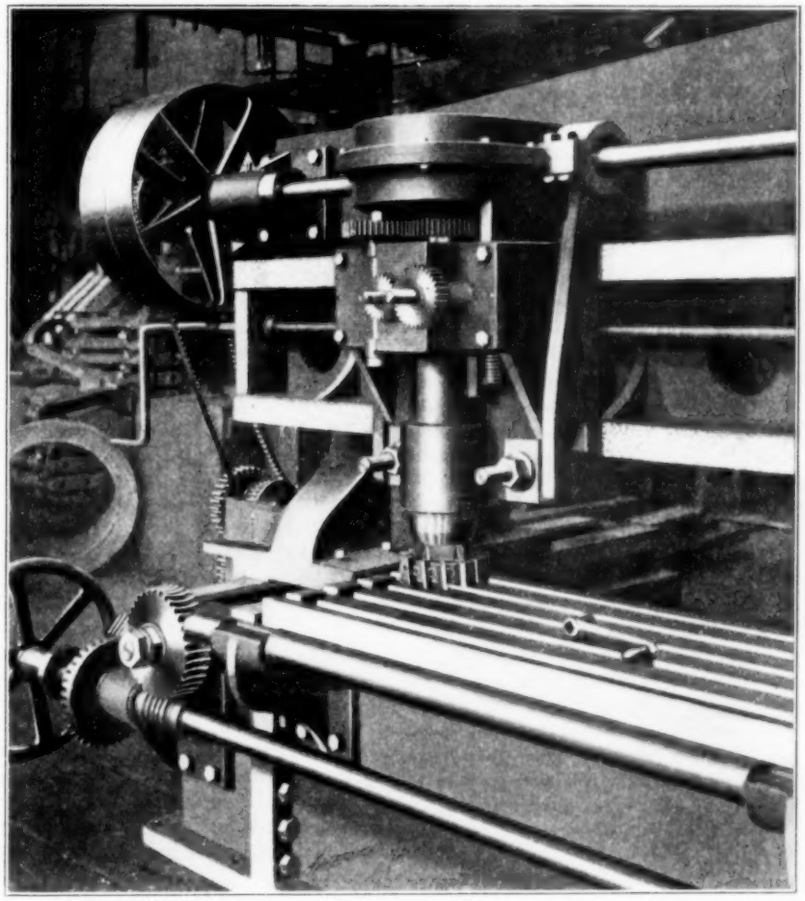


FIG. 5. THE CUTTER HEAD.

David Joy.

David Joy, best known to the engineering world through the Joy valve-gear, died in London, March 14, seventy-eight years old. We abstract a brief sketch of his career from eulogistic notices in our British contemporaries. His father was proprietor of oil mills at Leeds, and the son seems to have been a born mechanic, having made a model of a steam-roller when six years old, with various other devices as he grew older. His education, which was "completed" when he was sixteen, included a course in mechanical drawing, and then he entered his father's works, a drawing-office apprentice in the famous railway "foundry" of Shepherd & Todd, where he was brought in contact with Mr. Carrett, of steam pump fame, and a little later with Mr. Trevithick. His first work was on plans for a locomotive to carry 90 pounds, the pressures up to this time not having exceeded 60 pounds. This engine had the Gray valve-gear, with constant lead, and was probably the first locomotive with expansion gear. Changes in the business facilitated Mr. Joy's promotion, and about the time that he became of age he was made manager of the drawing office, and became intimately associated with the designing of the "Jenny Lind," the prototype of a design which was extensively employed and which crowded the works with business. At the age of twenty-five, Mr. Joy was appointed superintendent of the Nottingham & Grantham Railway, and a year or two later of another line. Soon after his thirtieth year he traveled on the Continent, representing several firms, and on his return he was able to begin his experimental and inventive career which he followed for the rest of his life. First he invented a hydraulic organ blower which was widely applied, then he worked on a marine propeller and a patent piston, and after these on a steam hammer, starting works for building the latter. He also engaged in the manufacture of a steam

Here there was not enough in the engineering line to satisfy him, and he became

riveter. Then came a compound engine for marine service, in which he utilized the first piston as a valve for the second cylinder. In consultation with the ironmasters of his district, Mr. Joy became interested in devising means for disposing of blast-furnace slag, and he originated the means for utilizing it, applying a blast of air and producing silicate cotton, now generally known with us as mineral wool. One of his futile inventions about this time was a revolving gun, which would rotate the projectile without rifling. In 1874 he went to the Barrow Shipbuilding Company as manager of the water-tube boiler department to work up the Howard boiler, which was a failure. The Joy valve-gear was patented in 1879, and found immediate appreciation and employment. It was taken up by Mr. Webb, of the London & North Western Railway, and by the Maudslays for marine work. It will be seen that Mr. Joy was a prolific inventor of wide range. His first paper before a technical institution was not presented until he had reached his fifty-fifth year. He visited the United States in 1882, attending the Niagara meeting of the Railroad Master Mechanics and reading papers on the Webb compound locomotive and on his own valve-gear. He has in later years been assisted in business by his son. He early became a member of the Institution (British) of Mechanical Engineers and later of the Institution of Naval Architects, and he was a vice-president of the Junior Institution of Engineers. He was a member from its foundation of the American Institute of Naval Architects and Engineers, and also a member of the Institute (British) of Marine Engineers. In later years he had been a noted figure at the meetings of the various technical societies.

Engineering Reminiscences—IX.

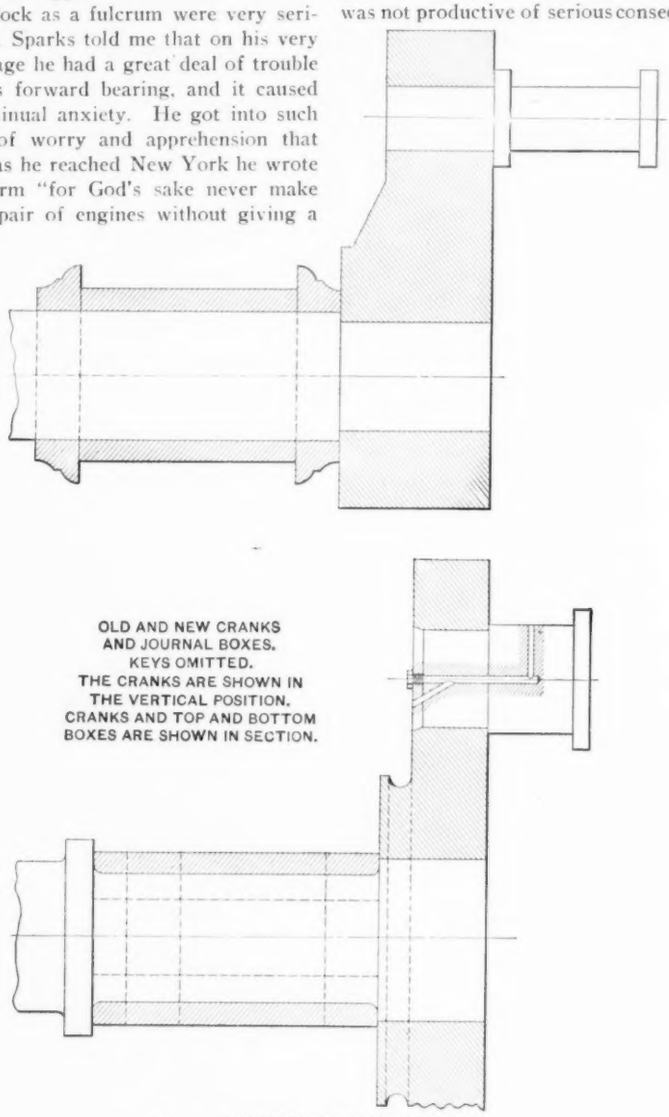
[Copyright 1902.]

BY CHARLES T. PORTER.

The success of the stationary and the marine governors and of the engine and the indicator fired me, in the summer of 1861, with the idea of taking them all to the London International Exhibition the next year. The demonstration of the three latter seemed to have come in the very nick of time. For this purpose I fixed upon an engine 8 inches diameter of cylinder by 24 inches stroke, to make 150 revolutions per minute, and at once set Mr. Richards at work on the drawings for it. I thought some of speeding it at 200 revolutions per minute, but feared that speed would frighten people. That this would have been a very foolish step to take at once became afterwards quite apparent.

I now took a more prominent part myself in steam-engine design. I had got an idea from Mr. Sparks that took full possession of my mind. This was, the exceedingly unmechanical nature of the single or overhanging crank. The engines of the "New York," built by Caird & Co., of Greenock, were among the first of the direct inverted cylinder engines applied to screw propulsion. They were then known as the steam-hammer engines, their leading feature being taken from Mr. Nasmyth's invention. I am not sure but Caird & Co. were the first to make this application. The forward engine had a single crank. The vital defect of this construction became especially apparent in these vertical engines of large power. The stress on the cap bolts during the upward strokes and the deflection of the shaft alternately in opposite directions over the pillow block as a fulcrum were very serious. Mr. Sparks told me that on his very first voyage he had a great deal of trouble with this forward bearing, and it caused him continual anxiety. He got into such a state of worry and apprehension that as soon as he reached New York he wrote to the firm "for God's sake never make another pair of engines without giving a double crank to the forward engine." The reply he got was, to mind his own business. They employed him to run their engines; they would attend to the designing of them. He told me not long after that he had the satisfaction of seeing every ship they built except his own disabled, either by a broken shaft or broken pillow-block bolts. He attributed the escape of the "New York" from a like disaster to his own extreme care. They did, however, adopt his suggestion on all future vessels, and, moreover, added a forward crank and pillow-block to the engines already built. This they evidently found themselves compelled to do. I saw this addition afterwards on the "Bremen," sister ship to the "New York." The added pillow-block was supported by a heavy casting bolted to the forward end of the bed-plate.

I went everywhere visiting engines at work and in process of construction, to observe this particular feature of the overhanging crank, which was universal in horizontal engines. In this class of engines, running slowly, its defective nature was not productive of serious consequences, because no stress was exerted on the cap bolts and the shaft was made larger in proportion to the power of the engine, as it had to carry the flywheel. But I was astonished to see the extent to which the overhang of the single crank was allowed. Builders seemed to be perfectly regardless of its unmechanical nature. First, the crank-pin was made with a length of bearing surface equal to about twice its diameter; then a stout collar was formed on the pin, between its bearing surface and the crank. The latter was made thick and



OLD AND NEW CRANKS AND JOURNAL BOXES. KEYS OMITTED. THE CRANKS ARE SHOWN IN THE VERTICAL POSITION. CRANKS AND TOP AND BOTTOM BOXES ARE SHOWN IN SECTION.

FIG. 1. ENGINEERING REMINISCENCES.

a long hub was formed on the back of it. I was told that the long hub was necessary in order to give a proper depth of eye to receive the shaft. This being turned down smaller than the journal, so that the crank might be forced on up to a shoulder, the eye needed to be deep or the crank would not be held securely. Finally, the journal boxes were made with flanges on the ends, sometimes projecting a couple of inches. Altogether, the transverse distance from the center line of the

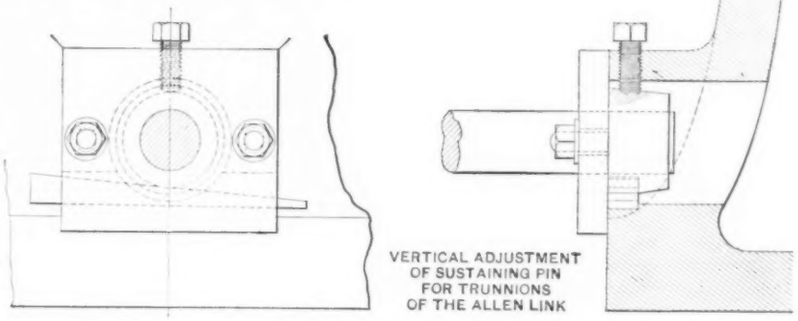


FIG. 2. ENGINEERING REMINISCENCES.

engine to the solid support of the shaft in the pillow-block was about twice what it needed to be. I also saw in some cases the eccentric placed between the crank and the pillow-block. Fifteen years later I saw a large engine sent from Belgium to our 1876 Exhibition which was made in this manner.

I determined at once that such a construction would not do for high-speed engines, and proceeded to change every one of these features. The single crank could not be avoided, but its overhang could be much reduced.

The accompanying sketches (Fig. 1) show the changes which were then made, and all of which have been retained. The inside collar on the crank-pin was dispensed with and the diameter of the pin was made greater than its length, the projected area being generally increased. The shank of the pin was made larger and shorter, and was riveted at the back. Instead of turning the shaft down smaller than the journal to receive the crank, I made it with a large head for this purpose. The keyway could then be planed out and the key fitted above the surface of the journal, and the joint was so much farther from the axis that but little more than one-half the depth was required in the crank eye.

Mr. Corliss had already discarded the flanged boxes. He also first made this bearing in four parts. The wear in the horizontal direction, the direction of the thrust, could then be taken up. For this purpose he used two bolts behind the front side box only. I modified his construction by making the side boxes wider, and taking up their wear by wedges behind both of them, thus preserving the alinement. One wedge could also be placed close to the crank. The dotted lines show the width of the side boxes and the location of the wedges. The shaft was made with a collar to hold the bearings in place, and was enlarged in its body. The substitution in place of the crank of the entire disk carrying a counterweight completed these changes. This was the fruit of my first lesson in high-speed engine designing, which had unconsciously been given to me by Mr. Sparks.

I had another piece of good luck. I happened one day to see in the Novelty Iron Works the hubs being bored for the paddle wheels of the new ship for the Collins line, the "Adriatic." These were perhaps the largest castings ever made for such a purpose. I observed that they were bored out only half way around. The opposite side of the hole had been cored to about half an inch greater radius, and three key-seats were cored in it, which needed only to be finished in the keyseating machine. The idea struck me that this would be an excellent way to bore flywheels and pulleys. As commonly bored, so that they could be put on the shaft comfortably, they were bored too large, their contact with the shaft could then be only on a line opposite the key, and the periphery could not run perfectly true.

I adopted the plan of first boring to the exact size of the shaft and then shifting the piece about an eighth of an inch, and boring out a slender crescent, the opposite points of which extended a little more than half way around. The keyway was cut in the middle of this enlargement. The wheel could then be readily put on to the shaft and when the key was driven up contact was made over nearly one-half the surface and the periphery ran dead true. I remember seeing this feature much admired in London, and several times heard the remark, "I should think the key would throw it some."

To prevent fanning I made the flywheel and pulley with arms of oval cross-section. These have always been used by me. They have done even better than I expected. They are found to impart no motion to the air, however rapidly they may be run.

The Allen valve gear required the position of the eccentric to coincide with that of the crank, that these should pass their dead points simultaneously. To insure this and to make it impossible for the engineer to advance his eccentric, which he would be pretty sure to do if he could, I made the eccentric solid on the shaft. This also enabled me to make it smaller, the low side being brought down to the surface of the shaft. The construction, moreover, was substantial and saved some work.

From the description of the link motion given in the preceding article, it will be seen that the correct vertical adjustment of the trunnions of the link was an important matter. To enable this adjustment to be made with precision, and to be corrected if from wear of the shaft bearings or other cause this became necessary, the pin on which these trunnions were pivoted was secured to the side of the engine bed in the manner shown in Fig. 2. To hold the wedge securely, the surface of the bed below was reduced, so that the wedge was seized by the flange.

All eccentrics that I had seen were flanged on each side, to keep the strap in place. I observed the oil to work out freely between the flanges and the strap. This action would of course be increased in high-speed engines. So I reversed the design, as shown in Fig. 3 of these two bearings at the top.

It will be seen that the more rapid the speed, the more difficult it becomes to keep the oil in the first bearing, and the more difficult it becomes for it to get out of the second one. I ought to have adopted the same construction for the main shaft journal, but in all the years I was making engines it never occurred to me. I contented myself with turning a groove in the hub of the crank, as shown in Fig. 1, to prevent the oil from getting on to the disk.

The problem of crank-pin lubrication at high speed at once presented itself and had to be met. I solved it in the manner shown in Fig. 1. A wiper was bolted on

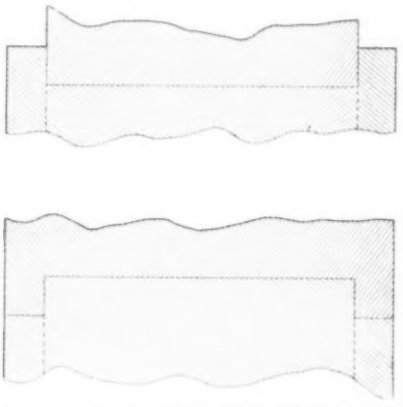


FIG. 3. CHANGES MADE IN ECCENTRICS AND STRAPS.

the back of the crank, and from it a tube entered the diagonal hole in the pin. This always worked perfectly. Other devices have been employed by various makers of high-speed engines, but I always adhered to this one. It has the advantage of being equally applicable to double-crank engines.

Aside from the above features, the design for my exhibition engines was made by Mr. Richards.

Layout of Corliss Valve Gears—I.

BY SANFORD A. MOSS.

It will be the purpose of this article to give a method for laying out a Corliss or other similar valve gear, using as a starting point the desired percentages of compression and release. The method at present in use does not involve these quantities, but is based on empirical tables of "laps."

Now, two engines having the identical steam distribution, but having slight differences in the proportions of the various links, arms, etc., will also have slightly different laps. Hence the lap is a rather unsatisfactory quantity on which to base the design. Moreover, the methods at present in use will only give good results in the hands of a designer of considerable experience, while the method we shall discuss may be used by anyone.

The basis of the method to be given is due to Professor John H. Barr, of the Department of Machine Design, Cornell University.

We shall consider only the single eccentric type of gear, for which, as we shall see presently, the cut-off is always less than one-half. The double eccentric Corliss gear with long range cut-off is based on somewhat different principles. We shall consider only the kinematic features of the design and not the constructive features.

GENERAL DESCRIPTION.

Fig. 1 shows the arrangement of the Corliss valve gear now most generally used. The various common modifications of this arrangement will be referred to later.

The eccentric, by means of the eccentric rod, rocker arm and reach rod, causes the wrist-plate to oscillate back and forth. On the wrist-plate are placed the steam and exhaust pins which operate the steam and exhaust links respectively. These links serve to operate arms attached to the valves. The exhaust valves are attached directly to the exhaust arms, and they rock back and forth with the wrist-plate, opening and closing the exhaust ports at the proper time. The steam valves are operated somewhat differently. Each steam link oscillates a "bell crank," which is loose on the steam valve stem. On this bell crank is a latching gear of some kind which is arranged to take hold of a steam arm directly attached to the steam valve. As the bell crank moves, the steam valve is thus made to follow it, and thereby open the steam port.

However, as the latch on the bell crank moves, it presently reaches a stationary "knock-off cam," and the further motion of the bell crank forces the latch against this cam, so that the latch is released and the bell crank can no longer pull the steam arm with it. The steam arm is always acted upon by a downward pull from the dash-pot. Hence as soon as the knock-off cam causes the latch to release, the steam valve is pulled shut by the dash-pot, and "cut-off" occurs. The position of the knock-off cam is changed by the governor, so that the time of cut-off varies with the load on the engine, in order to keep the speed constant. Various forms of latch mechanism are in use besides that shown in Fig. 1.

Fig. 1 shows the mechanism in the "lower central position"—that is, with the eccentric vertically downward. Each point on the wrist-plate is then evidently in the center of its motion. Arrows indicate the directions in which the various parts are moving. The piston has very nearly reached the "crank end" of its stroke, and the crank end steam valve is almost ready to open, in order to admit steam to drive the piston on the backward stroke.

The amount by which the crank end steam valve closes the port in the position shown in Fig. 1 is called the "steam lap." The head end steam valve was pulled shut by the dash-pot some time before the position shown. The bell crank then proceeded to the end of its travel by itself, and it is now going back again after the steam valve in order to pick it up and cause it to open the head end steam port at the proper time.

Since the wrist-plate is in the center of its motion in the position shown, the crank end exhaust valve is in the same situation as is shown for the head end exhaust valve, but it is moving in the opposite direction with respect to its port, and is therefore just closing after having caused compression. The amount by which the exhaust valves close the ports in the position shown is called the "exhaust lap."

Each of the valves moves back and forth as the eccentric moves back and forth, exactly as would be the case with the various edges of a common slide valve. There is a distorting effect due to the obliquity of the links in the Corliss gear, but this

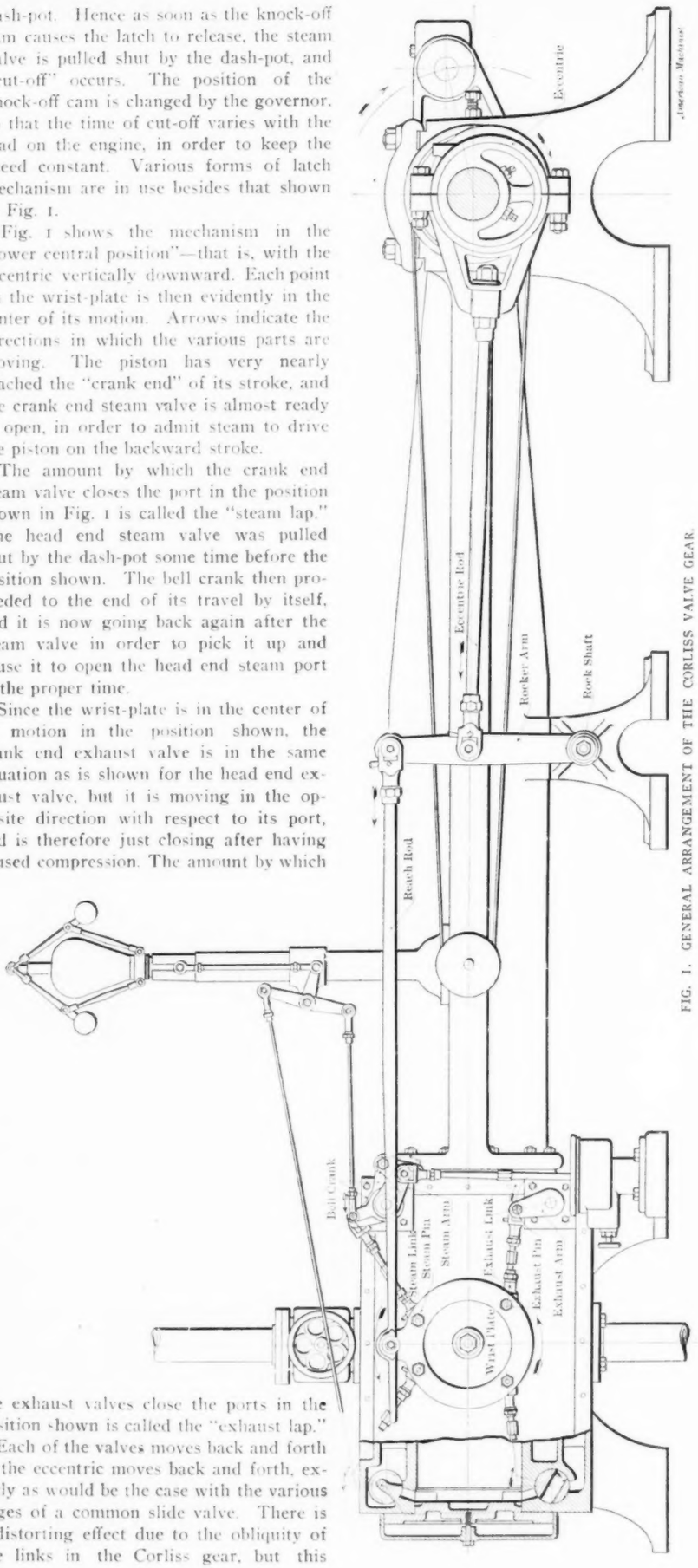


FIG. 1. GENERAL ARRANGEMENT OF THE CORLISS VALVE GEAR.

merely varies the speed with which the valves move. Therefore admission, release and compression are effected by the eccentric in very much the same way with a Corliss valve gear as with a common slide valve.

We shall now discuss the general theory of the design and afterwards the actual methods by which the theory is worked out on the drawing board.

LAP AND ANGLE OF ADVANCE.

In all descriptions of the action of the common slide valve will be found reasons for the use of "lap" and "angle of advance." For the same reasons, which need not be repeated here, a Corliss valve gear has "lap" and "angle of advance." The lap of a slide valve is the amount by which the valve closes the port when both eccentric and valve are in their central positions. The lap of a Corliss valve is the amount by which the valve closes the port when the eccentric and wrist-plate are in their central positions. However, the valve itself is not then in the center of its travel, owing to the distorting effect of the link and wrist-plate.

The eccentric of a Corliss engine is therefore, for the reasons stated, placed ahead of the crank by 90 degrees plus an "angle of advance." In Fig. 1 the angle of advance is the angle between the crank and the horizontal center line.

As has been stated, when the mechanism was slightly before the position shown, the crank end exhaust valve was line and line with its port, and when the mechanism is slightly beyond the position shown, the head end exhaust valve will be line and line.

Let us assume that the exhaust links are of the same length, as is usually the case; that the exhaust arms and other parts of the exhaust mechanism are also similar, and that the mean position of the rocker arm is perpendicular to the eccentric rod.

Then the two wrist-plate positions, for one or the other of the exhaust valves line and line, *make equal angles on opposite sides of the central position of the wrist-plate.* Evidently the angles passed over by the eccentric between the two line and line positions and the central position are also equal. That is to say, if c and r, Fig. 2, are the positions of the eccentric center for crank end compression and head end release respectively, then the angle $m\,O\,r$ is equal to the angle $m\,O\,c$. If C and R are the crank positions for crank end compression and head end release and M is the crank position when the eccentric is at m, then evidently the angle $C\,O\,M$ is equal to the angle $M\,O\,R$. Hence $M\,O\,B$ is the angle of advance, since M is the crank position for the eccentric at m. Now suppose that we have given the desired percentages of compression and release. We may lay off C' such that $\frac{C'\,A}{A\,B}$ is the desired compression ratio and $\frac{R'\,A}{A\,B}$ is the desired release ratio. Then C and R are taken vertically above C' and R' and M is taken midway between. Then $M\,O\,B$ is the angle of advance.

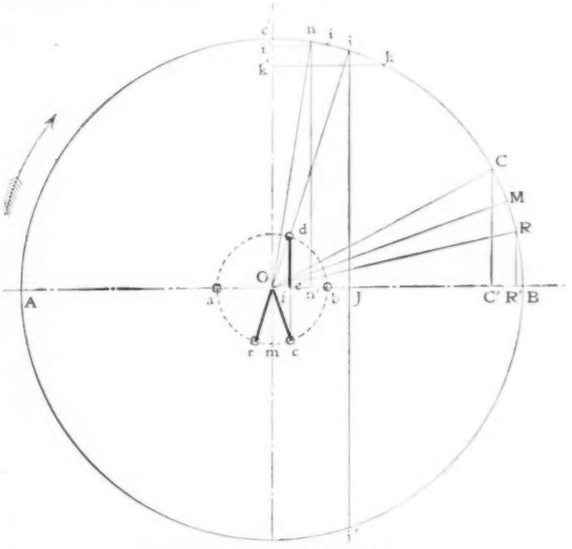


FIG. 2. ADVANCE ANGLE DIAGRAM.

In laying out a Corliss engine gear, it is most convenient to proceed as follows: Suppose, for instance, that we desired release at 98 per cent. and compression at 92 per cent. Take $c'\,i'$ equal to .02 of $A\,B$ and $c'\,k'$ equal to .08 of $A\,B$. Project to i and k and locate j midway between. Then $c'\,O\,j$ is the angle of advance. The circle used to determine this angle may of course have any diameter that we please, regardless of scale, and we shall later find it convenient to use a circle through the steam pins on the wrist-plate.

We have neglected the obliquity of the connecting rod, which is very slight, however, as the events considered occur very near the ends of the stroke. Actually, compression head end will be very slightly less and compression crank end an equal amount greater than the mean value used in Fig. 2. Release will vary in the opposite manner. By making the crank end exhaust link slightly longer than the head end link the compression may be equalized on the two ends, but then the release will vary twice as much as before.

LIMITING POSITION OF CUT-OFF.

Now let us consider the connection between the angle of advance and the steam valves. As stated, the crank end steam valve opens shortly beyond the position shown in Fig. 1, and continues open during all or part of time that the eccentric and bell crank move from right to left. The knock-off cam can only cause the latch to release the steam valve while the motion is in this direction. That is to say, if the latch has not released and cut-off occurred before the wrist-plate reaches the extreme left-hand position, then the steam valve will not be released at all and the governor will not control the cut-off. When the wrist-plate is in this extreme position the eccentric is at a and the crank at j' Fig. 2. Hence the piston position corresponding to the crank position j' is the latest one for which the governor can cause cut-off on the crank end. There is a similar crank position diametrically opposite j' which gives the latest point of cut-off, head end.

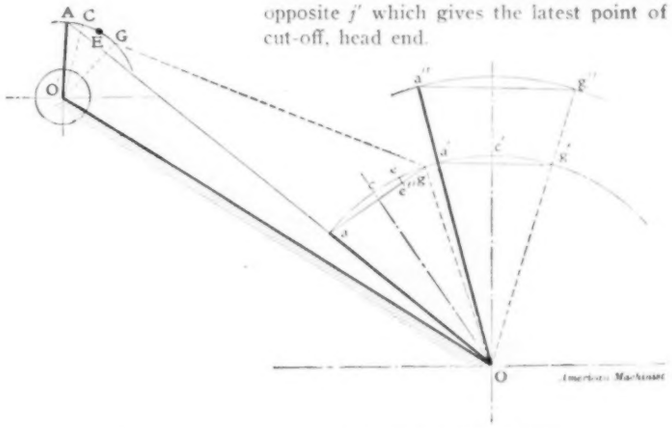


FIG. 3. STEAM VALVE CONNECTIONS.

Owing to the obliquity of the connecting rod, the percentages of stroke for these latest points of cut-off are different for the two ends. The mean of the two is evidently given by the point J. That is to say, $\frac{J\,B}{A\,B}$ is the fraction of the stroke giving the mean of the values of the latest points of cut-off for the two ends. The latest point of cut-off crank end is the least and determines the maximum capacity of the engine. Occasionally, in order to slightly increase the capacity, the latest point of cut-off is equalized on the two ends by making the rocker arm inclined to the eccentric rod.

The latest point of cut-off is evidently somewhat less than half stroke. The less the angle of advance the nearer it is to half stroke. Hence, in order to increase the capacity of the engine, the angle of advance is made as small as possible. This is done by making the percentages of compression and release as great as possible.

since the angle of advance is given by a point half-way between the two.

CUSHION AND EXHAUST LEAD AND LAP.

The compression must occur early enough to give a proper "cushion." It varies from 90 to 98 per cent., according to circumstances. The release must occur early enough to give a proper "exhaust lead." The "exhaust lead" is the amount that the exhaust valve is open when the piston starts on the exhaust stroke. If the exhaust lead is insufficient, the exhaust will be restricted at the beginning of the exhaust stroke, giving an indicator diagram with "turned-up toes." On the other hand, an early release must be avoided, as then the end of the expansion line will be lowered. It will usually be found that if release occurs from 98 to 99½ per cent. of the stroke, the exhaust lead will be sufficient.

At one period in the history of Corliss engines it was common to have the release percentage less than the compression percentage. Then the points *c* and *r*, Fig. 2, would be interchanged, and the exhaust valves would be open by a small amount when the wrist-plate was central, giving "negative exhaust lap." If we assume that the point *C* is fixed in order to give proper cushion, then the effect of making the release less than the compression and using negative exhaust lap will be to increase the angle of advance and reduce the capacity of the engine. With the compression at present usually used in Corliss engines the exhaust lead will be ample if release is greater than compression. Therefore in order to decrease the angle of advance and increase the amount of latest cut-off, the exhaust lap should be positive. However, with very late compression the exhaust lap may properly be negative.

Even with as small an angle of advance as possible the range of cut-off of a single wrist-plate Corliss engine is too small for some purposes, and then a "double wrist-plate" is used. In this case one eccentric with an angle of advance determined as in Fig. 2, operates the exhaust valves, and another eccentric with a "negative angle of advance" operates the steam valves, thus giving later cut-offs. We shall not discuss the double wrist-plate motion.

When release and compression are fixed the angle of advance may be found at once. With a given angle of advance the compression may be varied, but the release then varies also in the opposite manner, since the points *C* and *R*, Fig. 2, must always be equally distant from *M*. Such a variation is often made after an engine is built, by altering the lengths of the exhaust links.

RELATIVE MOTION OF ECCENTRIC, STEAM PIN AND STEAM VALVE.

Let us suppose that we have now determined an angle of advance which gives satisfactory values to compression, release and latest point of cut-off, and let us determine how an eccentric with such an angle will move the wrist-plate. When the crank is at *A*, Fig. 2, the eccentric will be at *d*, since we have already laid out $c' O j$ as the angle of advance. The head end steam valve will then be open by the amount of the lead. When the steam valve has its greatest possible opening (supposing it remains hooked to the bell crank until the latest point of cut-off) the eccentric has its greatest horizontal displacement. That is to say, the eccentric is at *b* when the steam valve is widest open and the wrist-plate has its farthest displacement to the right. In other words, the steam valve must move from lead opening to maximum opening while the eccentric moves from *d* to *b*.

Owing to the great length of the eccentric rod and reach rod, the *horizontal displacement* of the eccentric is always proportional to the *horizontal displacement* of the reach rod pin. The rocker arm merely multiplies the motion. The motion of each point on the wrist-plate is also proportional to the motion of the reach rod pin. Thus, suppose that *a* and *g*, Fig. 3, are the extreme positions of any point on the wrist-plate, as, for instance, the steam pin. When the reach rod pin has reached any fraction of its stroke, measured on the chord $a'' g''$, the steam pin will have completed the same fraction of its stroke measured on the chord $a\,g$. Since the motion of the reach rod pin is also proportional to the horizontal displacement of the eccentric, it follows that the motion of the steam pin, measured on the chord $a\,g$, is exactly proportional to the horizontal displacement of the eccentric. Now, while the eccentric moves from *d* to *b*, Fig. 2, the horizontal displacement is the fraction $\frac{e\,b}{a\,b}$ of the total eccentric travel and therefore while the eccentric is moving through this amount the steam pin is moving through the same fraction of the distance $a\,g$, Fig. 3.

We have already found that *d* lies on the line $O\,j$, which gives the latest point of cut-off ratio. Therefore the fraction $\frac{e\,b}{a\,b}$, Fig. 2, must be the same as the latest point of cut-off ratio $\frac{J\,B}{A\,B}$. Suppose, then, that we take *e''*, Fig. 3, so that $\frac{e''g}{a\,g}$ is equal to the latest point of cut-off ratio. We have already found that the steam valve must be at the lead opening when the eccentric is at *d*. Therefore, when the steam valve is open by the lead, the steam pin must be at the point *e*, Fig. 3, where $a\,g$ is the total motion of the steam pin and $\frac{e''g}{a\,g}$ is equal to the latest point of cut-off ratio given by $\frac{JB}{AB}$, Fig. 2. Therefore the steam valve mechanism is completely determined if we arrange it so that the steam valve will move from lead opening to maximum opening while the steam pin moves from *e* to *g*, and from the fully closed position to lead opening while the steam pin moves from *a* to *e*, Fig. 3.

RELATIVE MOTION OF ECCENTRIC, EXHAUST PIN AND EXHAUST VALVE.

Next let us deduce a similar relation for the exhaust valve. When the eccentric is at *b*, Fig. 2, the crank end exhaust valve has its maximum opening, since the wrist-plate has its farthest displacement. When the eccentric is at *c* the compression begins and the exhaust valve is line and line with the port. That is to say, the exhaust valve moves from the maximum opening position to the line and line position, while the eccentric moves over a fraction $\frac{f\,b}{a\,b}$ of its total travel. Suppose we take $c'\,n$ equal to $j\,i$, Fig. 2. Since $j\,i$ is equal to $C\,M$ and since the angle $m\,O\,c$ is equal to $M\,O\,C$, it follows that $m\,O\,c$ is equal to $c'\,O\,n$. Therefore $\frac{n'\,B}{A\,B}$ is equal to $\frac{f\,b}{a\,b}$. Hence the exhaust valve must move from maximum opening to line and line position while the eccentric moves over a fraction $\frac{n'\,B}{A\,B}$ of its total travel.

By the same reasoning used in the case of the steam valve, it may be shown that the motion of the exhaust pin is proportional to the horizontal displacement of the eccentric. Therefore the exhaust valve must be line and line when the exhaust pin is at a point at a fraction $\frac{n'\,B}{A\,B}$ of its total motion, measured on a chord as before. The exhaust mechanism is then designed so that the valve moves the proper distances on either side of this position, just as was done in the case of the steam valve.

It may be remarked that the preceding statements hold good for any form of valve gear whatever in which rocking levers are moved by an eccentric by means of rods whose obliquities may be neglected.

It must be noted, however, that the statements made are only for the case in which the average position of that rocker arm directly driven by the eccentric, is perpendicular to the average position of the eccentric rod. As stated previously, the rocker arm is sometimes inclined, so as to equalize the latest points of cut-off on the two ends, and then appropriate corrections must be made throughout.

THE PORT WIDTHS.

The port widths are calculated by allowing a nominal value for the mean velocity of the steam passing through the port, supposing that the steam passes during a full stroke and that there is no cylinder condensation. Of course the actual velocity of the steam has some unknown value, which is, however, always proportional to this nominal velocity. Suppose we compute this nominal velocity from a number of engines whose ports are wide enough

to give a proper actual velocity, as shown by the indicator cards.

If we have this same nominal velocity in an engine being designed, then the unknown actual velocity will evidently have a proper value.

In calculating ports it is customary to assume that the engine has the greatest speed at which it will be possible to run it. This is of course greater than the normal or rated speed. The greatest possible rotative speed is about 100 revolutions per minute, unless the stroke is so long that this gives more than 800 feet per minute mean piston speed. In this event the greatest possible rotative speed is that which gives 800 feet piston speed.

Let v be the nominal velocity in feet per minute; k, the ratio of port width to cylinder diameter, usually taken as unity; n, the revolutions per minute; w the port width, and l and d, the length and diameter of stroke in inches. Equating the volume of steam passing through the port in cubic inches per minute, to the cylinder displacement,

$$12\ v\ w\ k\ d = \frac{\pi}{4}\ d^2\ l\ 2\ n$$

Hence the port width is given by

$$w = \frac{\pi}{24}\ \frac{n\ l\ d}{v\ k}$$

v is taken at from 5,000 to 6,000 for the exhaust port and from 7,000 to 8,000 for the steam port.

OVERTRAVEL.

In order to secure a greater rapidity of port opening, it is customary to make the maximum opening of the valve slightly greater than necessary to fully open the port. The excess opening is called "overtravel." It varies from ⅛ to ½ inch, depending on the size of the engine. It may be assumed as about ¼ of the port width.

The distance moved by the steam valve from the lead position to the full open position is therefore the port width minus lead plus overtravel. As we have already found, the steam pin moves over a fraction of its stroke given by the latest point of cut-off ratio $\frac{J\,B}{A\,B}$, Fig. 2, while the steam valve moves over this distance. The critical point which we determined for the exhaust valve was the line and line position. Therefore the exhaust valve moves the port width plus overtravel in moving from the line and line position to the full open position, during which time the exhaust pin moves over the fraction $\frac{n'\,B}{A\,B}$ of its total travel.

THE VALVE SEAT BORE.

Next the valve seat bore must be decided. This is usually made the same for the steam as for the exhaust valves. The smaller the valve seat bore the greater the angular motion of the valve for a given port width. With too great an angular motion the links will form dangerously sharp angles with the arms at the extremes. To avoid this the valve seat bore should be small enough, so that the angular motion of the valve does not exceed about 40 degrees. Except for this there is no limitation whatever as to the valve seat bore. However, it has become customary to make the valve seat bore about one-fourth of the cylinder diameter. For very large sizes it is somewhat less and for very small sizes somewhat greater. It is usually convenient, but not at all necessary, to adhere to this rule.

LENGTH OF STEAM BELL CRANK.

Next we must determine the length of the steam "bell crank" or arm which is directly moved by the steam link, and to an extension of which the latch is attached. The only dimension of the mechanism which concerns us is the distance from the valve seat bore center to the pin moved by the steam link, and this we shall refer to as the length of the bell crank.

This distance should be great enough to give room for the various parts of the mechanism, as well as to give a low enough value to the pull exerted by the steam link in moving the valve. The longer the bell crank the greater the eccentric throw, however. It will usually be found convenient to take the bell-crank radius as about two and a half times the valve seat bore radius.

The length of the bell crank makes no difference whatever, so far as the kinematic problem is concerned, and as favorable a layout and as rapid a port opening are obtained with a long arm as with a short one, within reasonable limits. Therefore the bell crank may be less or greater than 2½ times the valve seat bore radius without any effect.

The angular motion of the steam valve is exactly the same as that of the bell crank, so long as the valve is hooked up. Therefore a point on the bell crank at a distance from the center equal to the valve seat bore diameter, will have a motion twice that of the valve when it is hooked up. It is usually convenient to lay out a Corliss valve gear half size. Hence the distance on the drawing passed over by a *point on the bell crank center line at twice the valve seat bore radius* will be the same as the corresponding distance passed over by the valve in the actual engine. We shall therefore confine our attention solely to the motion of this point.

RADIUS OF WRIST-PLATE STEAM PIN.

Next we must select the radius to the steam pin on the wrist-plate. This is usually taken as about the radius of the cylinder. Here, again, we may vary the radius greatly from this value without any effect. It is often stated that the greater the wrist-plate radius the quicker the port opening. This is not the case, however, and variation of the wrist-plate radius from about ½ to 1½ times the cylinder radius has little or no effect either on the rapidity of port opening or other matters.

KINEMATICS OF STEAM LINKAGE.

Next let us consider the manner in which the steam valve is moved by the wrist-plate. The portion of the wrist-plate carrying the steam pin is a lever which communicates motion to the steam link which in turn moves another lever, the steam bell crank. The two levers rotate about points which are fixed relatively to each other by means of attachment to the engine cylinder. Fig. 3 shows the mechanism diagrammatically. $O\,a$ is the wrist-plate lever, $a\,A$ is the steam link and $A\,O'$ the bell crank lever. $O'\,O$ is a fixed distance, and we may suppose that O' and O are held relatively to each other by a "fixed link." We have therefore what is termed in kinematics a "four link chain," the fixed link being $O'\,O$ and the others being $O\,a$, $a\,A$ and $A\,O'$. As already stated, the lengths of the links $O\,a$ and $O'\,A$ do not cut any figure and may be decided arbitrarily within reasonable limits. The length $O'\,O$ is of course determined by the dimensions of the engine cylinder. We have therefore to determine the total vibration $a\,g$ of the wrist-plate, the relative situation of the extreme positions of the steam pin a and g, and the length of the steam link $a\,A$. We have but one condition to satisfy, which is as follows: Let $\frac{e''\,g}{a\,g}$ be the latest point of cut-off ratio already referred to, and let E be the corresponding position of the bell crank. Then the distance $E\,G$ must be such that the angle $E\,O'\,G$ gives a motion to the valve equal to [port width — lead + overtravel].

SEAL AND LATCH CLEARANCE.

There are any number of solutions which satisfy the assigned condition, all of which differ in the distance $A\,E$ passed over while the valve is closed and the steam pin moves from a to e. The valve itself is closed by the dash-pot, so that when closed it covers the port by a constant amount called "seal." (This is also often called lap, but it is preferable to use the term lap only according to the definition previously given.) The bell crank must afterwards move back through this seal distance in order to be able to pick up the valve. To make certain that the latch will catch, the bell crank must go back a little farther than the valve. This amount is called "latch clearance" and may be about 1-32 inch, measured on the valve seat bore. The latch clearance must always be very small so that the bell crank will start to move the valve before it acquires any appreciable velocity. If the latch clearance is too great, the bell crank will strike the valve arm with a blow.

Since the valve is open by the lead when at E, the total motion of the bell crank from A to E, Fig. 3, measured on the valve seat bore, is equal to latch clearance + seal + lead. Since the latch clearance and lead are fixed and are both small quantities, the bell crank motion from A to E determines the seal—that is, the amount by which the valve closes the port when the dash-pot rod is in its lowest position. The seal needs to be sufficient

to prevent leakage of steam, but anything beyond this is useless and only causes idle motion of the bell crank and valve, giving extra wear and friction.

FUNCTION OF THE WRIST-PLATE.

The only advantage of the Corliss "wrist-plate" lies in the possibility of reducing this idle travel, so that the seal is little, if any, greater than necessary for safety against leakage. Suppose, for instance, the motion of the steam pin (or of the eccentric, which is the same thing) were transmitted to the bell crank without distortion, merely being multiplied or reduced. Then the ratio of the seal to the port width would be approximately $\frac{a\,e''}{e''\,g}$ Fig. 3. That is to say, the seal would be very much larger than the port. This is therefore the case in those types of Corliss engines which have no wrist-plate, but which have the reach rod connected directly to the bell crank. However, the introduction of the steam link causes a distortion of the motion so that the valve itself moves very slightly when closed and while the steam pin moves from *a* to *e*, Fig. 3; thus introducing what has been termed a "pause effect."

The pause effect is obtained by tipping toward each other the arcs through which the steam pin and bell crank vibrate, in a manner to be described presently. The effect of the obliquities thus introduced is to distort the relative motion of the steam pin and bell crank. Suppose, for instance, that *c*, Fig. 3, is the central position of the steam pin. The corresponding position of the bell crank is *C*, which is considerably to one side of its center of vibration. A similar distortion occurs for all other points.

The distortion of the motion also affects the rapidity with which the port opens, but in a very slight degree. The change in rapidity of port opening as the seal is varied, is usually so slight that it can hardly be detected on the drawing board. We will discuss this point more fully later on.

THE PULL BACK.

As stated, we may reduce the seal by tipping the arc of vibration of the steam pin *a g*, Fig. 3, toward *O'*. Such a position may be reached that the steam link *a A* lies in a direct prolongation of the wrist-plate radius *a O*. When this occurs the link is said to be in the "radial position." If the link goes beyond the radial position the bell crank will start to pick up the valve while the wrist-plate is still on the back stroke. When the wrist-plate starts on the forward stroke the bell crank at first retreats and then starts forward again and picks up the valve. The motion of the steam pin *a* beyond the radial position giving this double change of motion is called "pull-back." An amount of pull-back which on the drawing board moves the bell crank an amount equal to slightly less than the latch clearance will on the actual engine probably only take up lost motion in the joints and stretch in the rods, and perhaps cause the bell crank to have a slight tremor. There is usually no objection to such an amount of pull-back. Any greater amount may cause the latch to strike the valve arm an extra blow, or if the latch clearance is made great enough to prevent this, the regular blow will be more severe. Therefore the pull-back is never allowed to be very great, and most builders even avoid pull-back altogether, and only go to the radial position.

Since pull-back decreases the velocity of motion of the valve at the extreme position, it also affects the velocity slightly during the time that the valve is opening. Therefore the closer the extreme position of the steam pin is to the radial position, or the farther beyond it goes if there is pull-back, the slower the port opens. However, this effect is very slight, and is hardly worth attention.

Of course it is evident, from a consideration of the relative position of the links, that the closer the extreme position of the steam pin is to the radial position, or the farther beyond it goes if there is pull-back, the less will be the seal.

MAXIMUM EXTREME ANGLE.

Another means of reducing seal is to tip the arc of vibration of the bell crank *A G*, Fig. 3, toward *O*. There is a limit to this, however, namely, when the angle *O' G g* becomes too great. Then there is danger that the mechanism will cramp while in operation, or that the wrist-plate will "flop over" while the engine is being started by hand. The angle should also be such that a slight shortening of the steam link, in order to increase the lead, will not make the angle too great.

A safe value for the angle *O' G g* is 135 degrees, but values up to 150 degrees are permissible. It may be shown by geometry that if the line of the steam link in its extreme position *g G*, Fig. 3, be extended beyond *G* it will be tangent to a circle whose radius is the bell crank length multiplied by the sine of the angle $(180^\circ - O'\,G\,g)$. If the maximum safe angle be taken at 135 degrees the steam link will be tangent to a circle whose radius is .7 of the bell crank radius. If the angle is taken at 150 degrees the factor becomes .5. It will be found by trial that there is a very slight increase in rapidity of port opening if the angle *O' G g* be increased.

FINAL CONDITIONS FOR STEAM MECHANISM.

In order to make the seal as small as possible, we must therefore make the angle *O' G' g* as great as possible, and go to the radial position or slightly beyond it. However, in most cases the seal, even when thus made a minimum, will be rather greater than necessary for safety against leakage. However, there is nothing further that can be done, and we must be content with this value.

We have now imposed additional restrictions on the mechanism, and must choose the points *a* and *g* and the link length *a G*, so that the motion of the bell crank corresponding to motion of the steam pin from *e* to *g*, Fig. 3, has the desired value already stated, and also so that *g G* is tangent to a circle with radius .7 of the bell crank, and so that *a* is at or slightly beyond the radial position. It is always possible to select the distance *g g'* from the wrist-plate center line to the steam pin, the arc of vibration of the wrist-plate *a g* and the link length *g G*, so that the three conditions may be satisfied. The actual solution is best found by "trial and error"—that is, by assuming a solution and then correcting it so that the conditions are satisfied. Directions for procedure will be given later.

As was stated originally, the radii of the steam pin and bell crank cut no figure and an equally satisfactory solution may be obtained regardless of their values; that is to say, the rapidity of port opening and minimum amount of seal do not depend on the bell-crank and wrist-plate radii.

Echoes From The Oil Country.

RIDING HOBBIES—THE HOBBY OF RIDING.

Many people finding that their work is trying on the nerves, are apt to think that they are overworking, when the truth is they only need to take a ride once in a while. In "The Trials of Draftsmen," at page 303, Mr. E. R. Plaisted tells of some of their peace-destroying tribulations—and they are real enough, too, when you have to endure them—and tells how some of them can be reduced. There may be some who feel the need of all the nerve force that they can muster to keep in the place where they can feel that they have a right to growl a little, because they have had all the cause to worry. Very few want to go back to the job where nerve force and worry are not found, but I think that almost every one would be willing to do his work with as little wear-out to himself as he knows how. I have never found anything that is so great a help in counteracting the nerve racking tendencies of responsible machine-shop work as riding, and the very best thing to ride is a "hobby." Did you ever try doing something, since you quit playing marbles, that didn't amount to anything; something that you couldn't find anyone who would pay you a cent for doing; something that didn't interest anyone, unless it was some other "crank" just like yourself; something that the only one who cared how you did it, or whether you did it at all or not, was yourself?

If you never did it isn't much wonder you think you have the hardest job in the town. I think you have, too; but you are largely to blame for it yourself. Go and take a ride once in a while. No use saying you can't ride; of course you can, and it won't break you up doing it, either. If your first mount don't suit you, try another. Come this way some nice summer

day and I will give you one lesson free; and I am sure that I, at least, will have some fun out of it.

Perhaps some of you never expect to get into this part of the world, and would yet like the experience, so I will tell some things about one ride with a friend. The nerve racking he suffered from was caused by a "drafting and designing" department. That you may put yourself in his place I will call him Blank.

"Hello, Blank; what have you got on hand for to-morrow?"

"Nothing in particular. Why, is there anything you would like to do, or somewhere you would like to go?"

"Yes, let's take our wheels and go out for the day. I've wanted to go down Hemlock Creek for a long time. I tried to do it once and missed the way, and I won't feel satisfied until I try it again. What do you say, will you go along?"

"All right. I suppose you will want to start about the usual time. Well, I'll meet you at 6 o'clock by the fire engine house."

We met as agreed; each mounted on a "chainless," and started toward the east. It was just enough hazy to give promise of a fine day and we forgot that there was a machine shop anywhere around as we started up Sage run. By keeping in the valley we had a gradual grade of about 125 feet to the mile.

"See that young rabbit, and there goes another one. You won't be able to find any after the hunting season opens."

"That's what I was thinking when I saw the squirrel back there a ways. I'm going to sample these blackberries, though; you'd better stop, too. That's quite a nice posy, if only it don't wilt too quick. You'll have to furnish a pin, too, if you want to pin it on my coat."

"We may as well walk this hill. It is a long one, and there is a sandy strip beyond it that is hard to ride through."

"Say, wouldn't cumulative perpetual motion be useful on these hills, though? Just enough to let a fellow ride up without getting off."

"There is no use wanting the earth. If we were using automobiles we wouldn't see half as many things. See here, will you? And some folks say there aren't any green snakes in this country. They should see that fellow. You wouldn't hurt anything, so you can go on your way in peace; your past record saves you. You think a snake is a snake; well I suppose so, but there are snakes and snakes. To the right here, to the left at the next forks, and then straight ahead until we go down the hill into Hemlock."

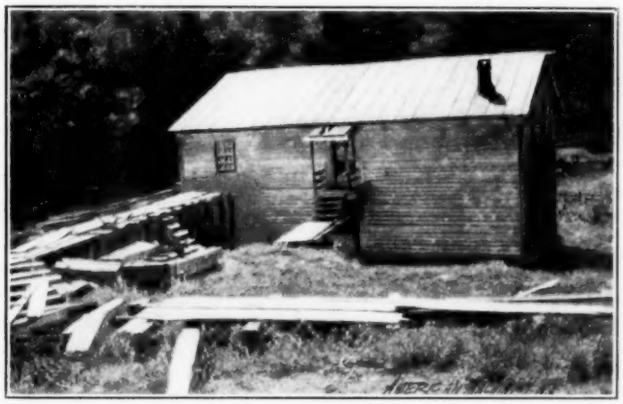
"What kind of a hill is this? I don't want to be too speedy on these hills; some of them come too near being straight up and down."

"Keep your brake well in hand, now; for we drop about 400 feet in less than a mile. The road is crooked and rocky in places, so you don't want to get going so fast that you can't jump off in case your feet lose the pedals; and look out for teams."

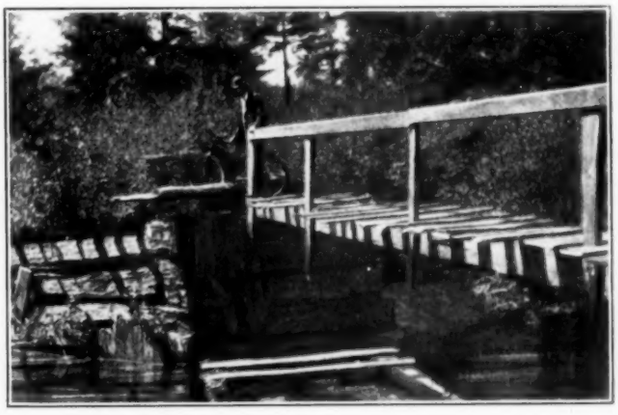
Down at the bottom, by the ruins of Clinton furnace, we turned down the stream. On down past Greer's mills, and past the relics of the dam where the sawmill had been. "This is where I was told to turn in to get on down the run. The road down the run was only a lumber road, and it may be a little hard to find it now, as it is several years since it has been used. It is lovely in here, though, cool and quiet, with the sweet smell of the pine and hemlock in the air."

"We can't pass this, Blank. Just see these blackberries, will you. Seems to be quite a patch of them. If there is a bear in this vicinity this is the place to expect to see him."

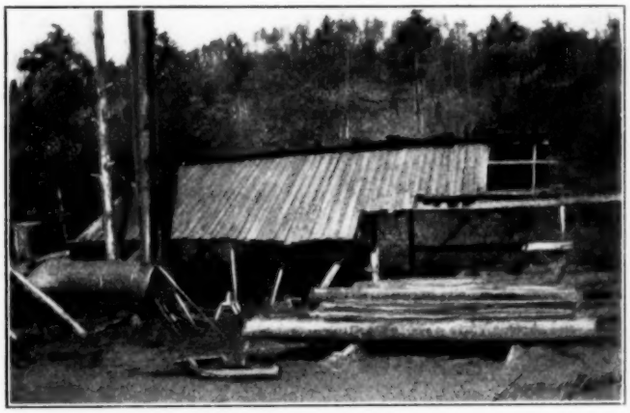
"The berries are all right, Will; but I haven't lost any bear, and if anyone else has I don't want to find it for him. But, say, do you know what time it's getting



GREER'S MILLS.



THE BRIDGE WITH BLANK AT THE FAR END.



THE SAWMILL.

THE HUNTER'S PALACE.

to be? I'm beginning to wonder where we are going to get dinner. How far are we from President, anyhow?"

"I am not at all sure, as I've never been over the road; but I should judge from the lay of the land that it was about five or six miles."

"I guess we had better leave these blackberries and get on down the creek if we expect to get any dinner; this isn't much of a road for speed."

We had not gone far when the road gradually shrunk up, and soon we were without any visible trail. As it had forked in numerous places, this did not surprise us. We were traveling *by* wheel, except in spots where it was necessary to lift them over logs or take them on our backs and carry them. Often we would come upon a nice road, grass grown and disused, but clear; then again we would be in the bushes where we had to tramp our way through. We would strike little ravines that we would let our wheels slide down into and then have to crawl up the other side holding on to the bushes and trees. It was glorious fun, with not a suggestion of machine shop in it anywhere, or dinner either. That was a novelty, too, as we had dinner as a regular thing on ordinary days.

There was just one thing that in any way marred my enjoyment; I had been the leader in this "short cut," and if we should run across a rattlesnake (we were in a section that has a very "snaky" reputation) or fail to get any dinner, I was afraid Blank wouldn't come out with me again. I went ahead and made enough racket, thrashing through the brush, to give any right-witted, fair-minded snake a chance to get out of the way. I kept my eyes on the rocks that we had to climb over, too. Some of the "natives" might have one for his bedroom and be enjoying a nap in the sun.

"Say, Will, this is getting to be something fierce," said Blank. "It begins to look as if we would have to lean our 'silent steeds' up against a tree and leave them if we ever expect to get out; we've done 'most everything except climb trees with them, and I'm nearly all in."

"We can't leave them, as we are about 16 miles from home when we do get out of this. It isn't quite 1 o'clock yet, and this can't last forever."

"Whoop! look up here, will you?" I looked, but did not see anything.

"That derrick; see, right up there." I looked where his finger indicated, but could not see any signs of a derrick. Could his lack of dinner be affecting his mind, I wondered.

"Come over here and you can see it." I went over, and there, sure enough, was a three-pole "derrick." It had so blended with the trees that I had not seen it before. That meant that we would find a road of some kind.

We had come upon one of the gas companies' gas wells, and we started down the "road," glad of a place where we could walk and lead the wheels. Soon we came to a crossing where a foot bridge, composed of a log with cleats nailed crossways, kept us from having to wade the creek. Across the creek we found a path where we could ride, and we were soon speeding down the way to the river. There were frequent bad spots where we had to walk, and at one such spot Blank spoke up: "Hark, do you hear that? Someone is using a hammer, as sure as you are alive." I could hear it sure enough, and I could also see the little sawmill that we just then came to. I had to stop long enough to get a picture of it, but Blank followed the sound of the hammering. When I caught up to him, he was sitting on a log looking across at a small shanty, where a man was hammering away at a door. We went over.

"Hello, neighbor." The man looked up in surprise, not any the less for seeing the wheels, but nodded a greeting.

"How far are we from President, or from some place where we can get dinner?"

"President is near about four or five miles, but I heared tell that the folks had moved away that used to keep the hotel there. There is a farmhouse up over the hill about a mile and a half, where you might be able to get dinner if you were to find the folks at home. 'Tain't likely you would, though, as this is a holiday."

"That farm is still farther from home, isn't it?" inquired Blank.

"Where are you going?"

"To Oil City, and I've got to get something to eat pretty quick or I'll never be able to get there."

"We might give you something to eat, but we couldn't set you up no dinner. We feed the mill men, but the boss furnishes the stuff. He is in town now after some, but you are welcome to what we have."

We were soon at work on some bread and butter, cold fried bacon, cucumbers and molasses, with a tin cup full of milk to wash it down, and some cold coffee at our service.

"Are you troubled with snakes?" I asked, to be friendly, like.

"Nothing to speak of. There was a blacksnake some over five feet long clim down over the door there, the other day, and nearly landed in my wife's lap." I looked inquiringly at the woman. "I killed it," she said. "I hain't just exactly afraid of them, but I don't like them. Folks said that if we came down in here we would be fenced in with rattlesnakes, but it isn't so. I haven't seen any, and the men at the mill have only killed three or four all summer. There was a bear up on the hill last week, so they say, but I didn't see it." She seemed quite well contented, even if the nearest house was a mile and a half away.

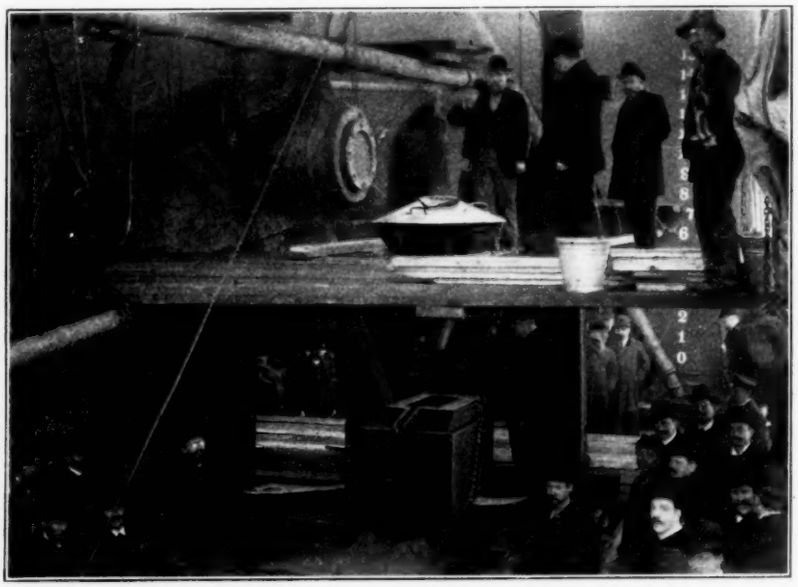


FIG. 1. WELDING A BROKEN RUDDER-POST—READY FOR THE OPERATION.

Going down the creek we had to take off our shoes and ford where the road crossed. Having had something to eat, we were not in any hurry, and had time to admire the beauties of the "hunter's palace" and other interesting places and still get home in time for supper.

To tell all the pleasures of that trip would take a week. I have heard that there *is* a road on the *other* side of that creek. I expect to know for sure some time next summer, and will be glad to have some of you for company.

I am not just sure as to what the exact curves of a trip should be to get the highest efficiency in the shop the next day, neither have I a formula that will give the increase due to any given trip; but, like my practice in lots of other things, I'm sure it's there if I can't prove it.

Take my advice: If you haven't a hobby already, get one and ride it; see that

it is a safe one, both for yourself and for others, and then *see that it doesn't run away with you.* W. OSBORNE.

Welding in Place the Broken Rudder-Post of a 9000-Ton Screw Steamer.

The single-screw steamer "Sevilla," of the Hamburg-American Line, had, in consequence of a collision with another steamer, a broken rudder-post. The break was 500 mm. (say 20 inches) high and 200 mm. (8 inches) wide. The usual way of repairing in such a case is to take out the broken post and put in a new one. This would have taken ten to twelve weeks and cost, including dock charges, about 80,000 to 100,000 marks, say between $20,000 and $25,000.

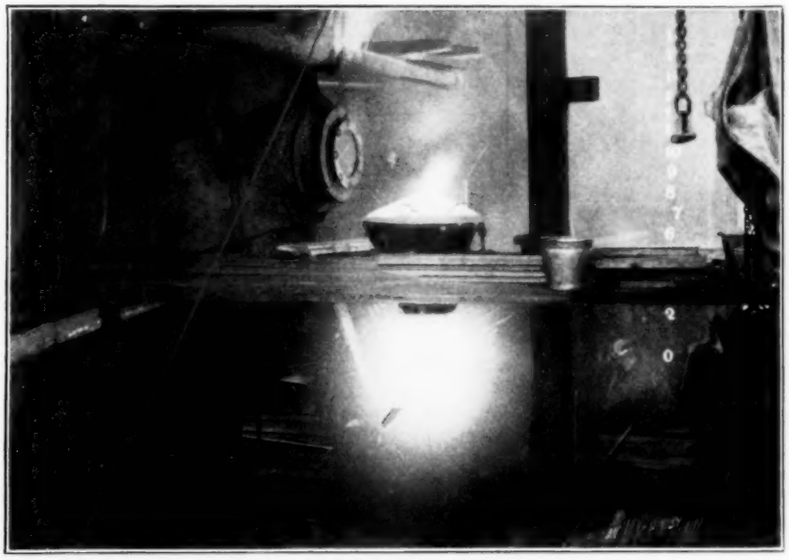


FIG. 2. WELDING A BROKEN RUDDER-POST—THE WELDING.

The broken post was, however, welded in place by the use of the new material, "thermit," the break being partly filled and partly "fished" by new iron. The filling was about 30 mm. (say 1.2 inches) thick and the "fishing" about 50 mm. (2 inches) wide and 150 mm. (6 inches) long. There were employed about 300 kilogs. (136 pounds) of thermit, which was ignited in an automatic crucible and tapped into the mold in the ordinary manner. The mold was made in the form of a two-part funnel lined with Eisenberger sand. The sand was rammed about a pattern, and the mold baked in an oven at a temperature of 150 to 200 degrees Cent., say 302 to 392 degrees Fahr. In contradistinction from the mode employed in a previous post-welding operation, the entire mass of slag was this time not retained in the mold, but the latter had an outlet, so that for the superfluous iron and slag there remained above the inlet and funnel only about 150 mm., say 6 inches, of room. The slag which could not find place in this space was run off by a side outlet and caught in a pile of damp sand. This was done because otherwise the contents of the box would necessarily have been very considerably increased, and because this would have considerably increased, also, the distance of the lower edge of the crucible from the inlet funnel. It is not considered desirable to have this distance more than 300 mm., say 1 foot, because otherwise very small obstacles, which would prevent the entrance of the stream to the crucible, would cause a divergence thereof and prevent it reaching the upper opening of the funnel.

FIG. 3. WELDING A BROKEN RUDDER-POST—THE JOB FINISHED—PLATES REPLACED—VIEW FROM THE OTHER SIDE.

The welding took place, after the post had been heated to redness, at 11.20 A. M., and the mold was left untouched until 4 P. M. When it was removed, the "fish" and the post were already cooled below redness. The funnel and the superfluous iron, covered with slag scales, were still dark red. The superfluous iron was held by means of the inlet funnel and the two others fast on the rudder-post. An unsuccessful attempt was made to break it off by heavy hammers. A heavy slung iron ram was therefore employed and swung by ten men, and about fifty blows of this were necessary in order to bend the funnel to a right angle from its first position. Therefore the various funnels, which were about 50 mm., say 20 inches, in diameter, were cold-chiseled part way through close to the post, and then about twenty more blows with the ram sufficed to break off the metal. This proved, at any rate, the excellent quality of the metal in the weld.

The soundness of the metal in the weld was tested by drilling two holes in different directions therein; the results were satisfactory.

The operation was inspected by the representatives of the German Lloyd, the English Lloyd, the Hamburg port authorities and many proprietors of Hamburg ship-yards and docks. The cost of the repairs, including all preliminary work and special expenses, came to only a few thousand marks. The mended place is now stronger than originally. As an additional precaution the entire rudder-post, as soon

as it was only warm, was reheated twenty hours in a mild charcoal fire.

ROBERT GRIMSHAW.

Hannover, Germany.

The Metric System in Spain.

We have a communication from J. H. Ball, of Barcelona, Spain, on the above subject, from which we print all the essential or pertinent parts. We are not informed as to whether Mr. Ball has used both systems in machine construction or not, and so are not quite sure that his testimony comes within our restrictions, but as testimony adverse to the metric system and coming within our classification, *i. e.*, testimony of men who in machine construction or mechanical engineering work have used both systems is exceedingly scarce, we stretch a point to make use of it. Mr. Ball is, we believe, an Englishman and is, or until recently was, a machinery sales agent in Barcelona. His letter is as follows:

"I have read with interest the series of articles and letters which have appeared on this subject, and note firstly that the advocates of the metric system seem in their enthusiasm to have lost sight of the subject of the discussion, which is not whether the metric system has or has not advantages, but whether it has so great a vantages over the English system, and advantages so easily obtainable that it is worth while to throw away the millions of dollars' worth of tools, machines, appliances and drawings now existent, which have been and are being made in pursuance of the English system, and which would be rendered useless if the standards are altered to metric.

"Mr. Koehler at page 129 says 'anyone claiming that the metric system is not thoroughly introduced in France, Germany, Italy, Austria, Belgium, Holland—yea, even Russia—must either in every meter see a yardstick or he must be blind; was in Rome and did not see the Pope.' I have no hesitation in saying that Mr. Koehler does not prove the first thing of what he asserts. The metric system may have been thoroughly introduced in some one shop with which he was concerned, but that one shop, or one-half dozen shops, does not constitute 'Germany.'

"If the advocates of the metric system want to see the difference between 'thorough introduction' and 'thorough adoption' let them go into any jobbing shop in any big town and find out how much of the repair work is on the metric scale, especially in the all-important screw and nut without which no single machine for any purpose whatever can be made.

"Here, in Spain, the sample depot of the rest of Europe, are machines of all sorts and of all nations, and not 5 per cent. of the screw pitches are of metric measure and not 25 per cent. of the screw diameters are metric. And, even worse, many machines arrive with some screws of English and others of metric measures in the same machine. How is that explainable if the introduction has been so thorough?

"I saw the other day two lathes just imported—bought from stock—one in Paris and one from Germany. The French lathe has lead-screw and all binding or mounting screws and nuts, and all gears cut to English pitches, but all the internal screws were French pitch, which could not be cut with the lathe they were supplied in. The German lathe was metric as to hight of centers, etc., but every screw, bolt or nut in it is of English pitch. Yet Germany has had metric measure by law established over thirty years, Spain thirty-three years, and France about one hundred years. The balance of seventy years in favor of France is represented by the metric pitch internal screws in the French lathe above quoted, and it is no single example. I know of a single shop close to me where are working seventeen machines of Swiss manufacture which show the same mixture of measures, and I am well acquainted with very many in which the machines carry either all screw work of English or of mixed measures. So much for the 'thorough introduction' in matters mechanical, and I would beg your readers to bear in mind that, as I have already pointed out, no machine can be built without screws, so that this apparently simple article is, in this discussion, a thing of the very greatest importance.

"In matters outside machinery I do not profess to be 'thoroughly' acquainted with other Continental countries, and therefore confine my statements to the measures reigning in Spain. The law rendering compulsory the metric system has, after thirty-three years' work, killed the yard and the foot measures. There were only some thirty different yards and feet before, so their loss is not to be deplored, but with very few exceptions all the other old Spanish measures and weights are quite well, thank you, and flourishing. Minerals go by the *tonelada quintal* and *arroba* just in the sweet, old way, while the *fanega* as a measure of capacity, the *palmo*, or span, the *libra*, or pound (differing in different provinces), the *canon* (1.555 meters) in dry goods, and an infinity of other measures that have nothing whatever to do with the metric system do quite as much business as the latter. Yet this is a country in which the famous metric has been 'thoroughly introduced' for over thirty years.

"But what difference does it make? Really very little. All who have to deal in goods using the old rules know those rules perfectly, and it is equal to them to calculate in one or the other. It is their business to know and they know, and their customers know; and that is all there is to it.

"Germany and Spain, split up in numerous petty states and provinces, had equally numerous sets of rules, and to attempt to unify them by the compulsory introduction of the metric system was a first-class thing to do in every way. But use has proved stronger than the law.

"I have no dislike for the metric system; I work with it or by it every day, but the English system is equally easy to me, for it is my business to know both, and in handling the numerous machines which I have to come across in my business I find only two nations whose measures are always uniform in all respects, and those two are England and the United States. All the others are—well—otherwise. To say the English measures are in some respects cumbersome, unwieldy or ugly may be true, but does not affect the case, and if your boy has received one black eye you don't improve his appearan e by giving him another.

"In this 'metric' country, if you want to buy a rule, vernier or tape, the stock article carries both metric and English markings, but the stock article is of French, German, Swiss or Belgian make. The only rules purchaseable which do not show English measures are of American make, and a nuisance they are, as one has then to carry two rules instead of one."

Solder for Aluminum.

A United States patent has recently issued for a solder for aluminum and its alloys. The solder consists of aluminum 5 parts, antimony 5 parts, and zinc 90 parts. To make it harder, use a little more antimony and a little less zinc. The following describes the process of making the solder and the mode of using it: The aluminum is first melted in a pot. The zinc is then added, and when this is melted the antimony is added. The metal is then thoroughly puddled with sal-amoniac. When the surface of the metal is quite clear and white, it should be poured into sticks ready for use, the cinder being first removed.

To make joints in aluminum with this solder, the two or more surfaces to be joined should be cleaned, either by scraping or using acid, and the surfaces should then be well coated with the solder, especial care being taken that the solder has to some extent penetrated into the surface of the metal without at the same time burning it. The parts to be joined should now be placed together and kept in close contact. Heat should then be applied till the solder melts, any surplus which squeezes out should be wiped off with any convenient instrument and the heat removed.

The United States patents taken out by T. A. Edison now number 790. The regular fees for these at $35 each amount to $27,650, and the total cost of merely working them through the Office was of course many times this amount. The number of the Edison patents up to 1895 was 711.

Mr. Davis's saw mill is laid up for repairs on account of breaking several teeth in the circle-saw.—*Hart* (Mich.) *Journal.*

Letters From Practical Men.

A Job of Milling.

Editor American Machinist:

A rather interesting piece of milling came to my notice the other day in the new shops of the Cincinnati Shaper Company—interesting enough, in fact, to warrant making the photographs which are reproduced herewith and show how this company machines its rocker arms. The piece is rather an awkward one to machine, and it was therefore somewhat surprising to find that it was finished all over on a miller at two settings, using the fixtures as shown in photographs.

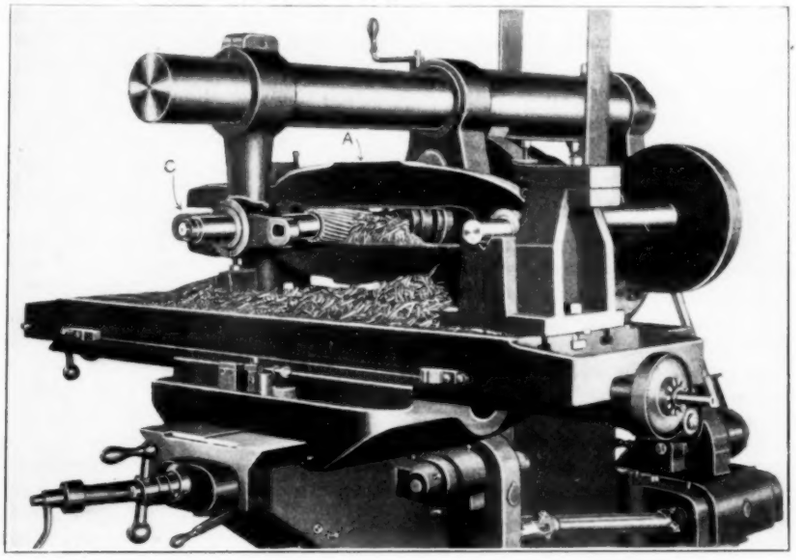


FIG. 1. MILLING A SHAPER ROCKER-ARM.

The principal dimensions are as follows: Slot, 2¾ inches wide, 2¾ inches deep and about 15½ inches long. The width of cut in Fig. 2 is 6¼ inches. The extreme length of casting is 26 inches, and extreme width 9¾ inches.

There are in all seven operations, beginning with milling the slot to size, as shown in Fig. 1. The cutter has a face more than twice the width of the cut. The roughing cut is taken with the work at one end of the cutter, and it removes about 3-16 inch metal at top and bottom of the slot at one time. For finishing, the work is moved out to the other end of the cutter, which is reserved for this operation, and a light cut is taken back along the bottom of the slot, returning with a second light cut along the top, which finishes the slot to size. In this way one cutter is made to serve for both roughing and finishing. Next the surface *A* is finished, using the same cutter, and then the slot *C* is milled to size in the manner described above. The sides of the fork are finished by using a gang, as shown in Fig. 2, and finally the side of the piece nearest the machine is surfaced with a 9½-inch face-mill. Then the piece is reversed in the fixture and the other side is milled, using the same face-mill, and the surface corresponding to *A* on the other side of the arm is finished with the cutter shown in Fig. 1. This completes the piece, and the cutter is in the machine ready for the first operation on the next rocker arm.

After watching the performance of the machine (which, as will be seen from the photographs, is a "Cincinnati geared-feed miller"), I was shown the time cards for the job, which brought out the fact that the time charged for milling is 2¼ hours for all the operations described. They have not been using this method "since the beginning," and therefore our curiosity carried us to the old records, from which we learned that they thought they were doing very well when the planing time was brought down to 14½ hours on each piece.

C. S. G.

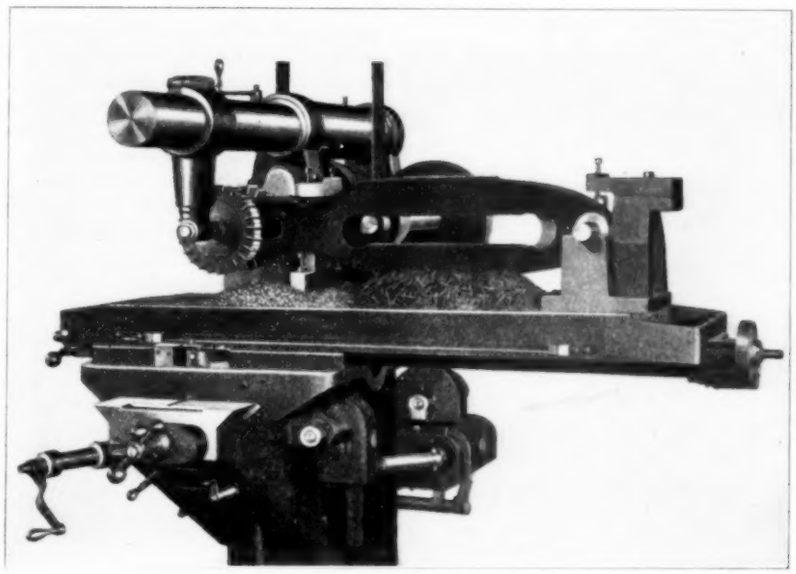


FIG. 2. MILLING A SHAPER ROCKER-ARM.

Our Index.

Editor American Machinist:

Mr. Howard L. Lyon (page 273) in looking up an article on "Electro Magnets" or Solenoids," could have found same under the caption "Electric," as well as under "Solenoids," in the 1902 index of the AMERICAN MACHINIST. It was also under the subject "Crane," to which it related and which was cross-indexed from "Design" and "Wiring," if not from other topics.

THE INDEXER.

An "Atmosphere" as a Measure of Pressure.

Editor American Machinist:

Your editorial at page 420, concerning an "atmosphere," brings pertinently to mind the general looseness of usage concerning pressure units and the difficulty of defining them exactly. An atmosphere is customarily defined in the following roundabout way when extreme accuracy is desired. It is the pressure exerted by a column of mercury 760 millimeters high, the intensity of gravity being supposed to be that at the sea level, 45 degrees north latitude. If the intensity of gravity is different, as it is at all other places on the earth, the column of mercury must vary slightly, in order to give the same actual pressure or force per unit area. The pressure "one atmosphere," or in fact any other unit of pressure, of course always means the same actual force, regardless of the part of the earth where it is used. In order to express the pressure in "pounds per square inch," "kilograms per square centimeter," or any other gravitation unit, we must allow for the variation of gravity. Of course the variation is insignificant for engineering purposes. However, a pressure gage of the ordinary Bourdon type makes allowance for this variation and measures absolute force.

An atmosphere as above defined is equal

to a pressure of 14.6968 pounds, or practically 14.7 pounds per square inch, or 1.03329 kilograms per square centimeter at sea level 45 degrees north latitude, and something very slightly different in every other part of the world. The only exact way to express a pressure is to use some absolute unit of force. Thus an atmosphere is 1,013,250 dynes per square centimeter.

The metric system, unfortunately, involves no unit of pressure, so that a great deal of confusion exists in pressure calculations where this system is used. Scientists use "millimeters of mercury," "dynes per square centimeter" and "atmospheres," while engineers in metric-using countries use "atmospheres" and "kilograms per square centimeter."

As the basis of a unit of pressure and for direct use in other cases, an invariable "unit of force" adapted to engineering purposes is necessary. The unit of force probably most convenient will be the force due to the weight of one kilogram at some particular place, since the force due to the weight of a kilogram is variable. The scientific unit of force would be some multiple of a dyne, as a "megadyne," which is slightly less than an atmosphere. That is to say, in order to secure the full advantage of the metric system, we should measure the load on a bridge in "megadynes," stresses in "megadynes per square centimeter," and so on. This would probably be inconvenient, however. At any rate, some one invariable unit of force most convenient to all concerned should be made a part of the metric system and used by everybody, if the supposed simplicity of units is to be realized.

It will be a great advantage if some such unit of force, and with it a unit of pressure, is made a part of the metric system eventually adopted in the United States.

SANFORD A. MOSS.

Cornell University.

[Our correspondent seems to succeed admirably in demonstrating the impracticability and unwisdom of using atmospheres in statements of pressure. Since there is no fixed atmospheric pressure anywhere, 15 pounds to the square inch, or 1 kilogram per square centimeter, would either of them seem to be acceptable if agreed upon and more convenient than any unit more elaborate.—Ed.]

Chain Grooves in Crane Drums.

Editor American Machinist:

At page 1508, Vol. 25, I showed a sketch of a crane drum herewith reproduced, Fig. 1. At page 301 of the present volume Mr. Wm. J. Ballantine says that this style of groove "has long been abandoned by manufacturers of cranes and hoisting machines," and he offers the sketch, Fig. 2, which he claims "has superseded it," incidentally remarking that molds for these grooves are generally made by sweeps and they are seldom machined after.

It is stating the case too strongly to say that this groove has been abandoned either for a long or a short period. So far as I have been able to learn, the groove shown by Mr. Ballantine is used only in a minority of instances. At the works of the Hydraulic Machine Company, Pittsburgh, with which I have been connected until quite recently, we constructed a large number of cranes ranging from 5 tons to 75 tons, for service in some of the principal steel works in this country, and always used

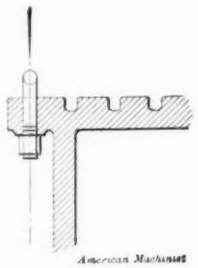


FIG. 1. CHAIN GROOVES IN CRANE.

the groove, Fig. 1, requiring the drum to be turned to assure its being cylindrical in form and concentric with the shaft. Before commencing to build traveling cranes at this plant, we had put into service two cranes built by the Morgan Engineering Company, grooved as shown in Fig. 1, and I have not learned that they have changed their practice in this respect. We also had one crane built by the Shaw Electric Crane Company grooved the same way, although I am given to understand that this company had previously built a few cranes with the chain laid as in Fig. 2, but they have not done so in recent years. I have been told that this style of groove is not by any means new—that is, that it is thirty years old or more—but, on the other hand, it is proper to state that Wm. Sellers & Co. have used this groove exclusively for a considerable time, and, so far as they are informed, they were the first to introduce it. At the great works of the Westinghouse Company at East Pittsburgh, there are a large number

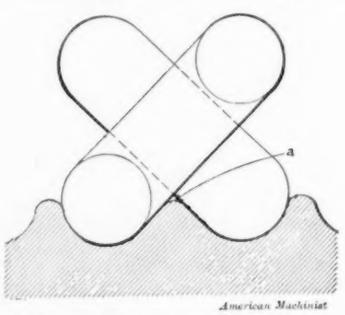


FIG 2. CHAIN GROOVES IN CRANE.

of Sellers cranes all grooved in this way, but possibly a still larger number of Morgan cranes all grooved as in Fig. 1. There are also a great many built by the Westinghouse Company for their own use all grooved as in Fig. 1. Pawling & Harnischfeger always use Fig. 1 unless in such an exceptional case that it is impossible to provide room for it, and they invariably have the drums turned. This firm is strongly in favor of the use of wire rope as a substitute for chain in crane service.

There are other builders who use the groove shown in Fig. 1, but, as I have been able to learn of only one who does not use it, perhaps there has been as much said as the occasion calls for.

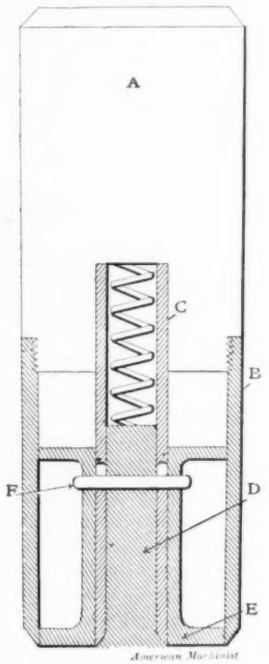
GERALD E. FLANAGAN.

Improved Washer Punch.

Editor American Machinist:

At page 385 "Experience" gives us a sketch of a punch which he designed. His punch, while it would do the work intended, could have been made much cheaper and simpler.

In 1894, while assistant foreman in the Crane Company's toolroom in this city, I designed a punch on the same principle but, as I say, of simpler construction. After making the first one, I had the punches made of all sizes from ⅛-inch



IMPROVED WASHER PUNCH.

hole and 5-16 outside diameter up to 2-inch holes and 4 inches outside diameter, to punch all kinds of material—rubber, felt, paper and leather. I punched with a mallet and hand punch as high as 800 pieces per hour.

All of the punches were made so that they could be used in our power presses if desired, but we never found it necessary to do so, as even the 4x2-inch punch would cut clean and easy with one blow of the mallet in 3-16 inch harness leather.

Referring to the sketch of my punch, shank *A* is threaded to a shoulder and bored to receive *C*, which is the same diameter as the hole in the washer. It is a drive fit in the shank, with an elongated hole to receive pin *F*, which is fitted into plungers *D* and *E*, so that they move together. To assemble the punch, insert *C* into *A*, drop the spring into the bore of *C* followed by plunger *D*. Place plunger

E outside of punch *C* and push *D* back till the holes coincide. Place pin *F* in position and screw on the outside punch *B*, which is knurled to give a good grip in working. W. R. C.

Chicago, Ill.

High Duty Machine Tools.

Editor American Machinist:

Your "Justification," at page 259, of the modern "high duty" (as they use the term when talking about a pumping engine) lathe suggests a topic for a discussion which might be engaged in with profit, and I hope some of the fellows will have something to say about it. The present writing is intended chiefly as a provocative.

Is the high-duty lathe a freak, or is it the pioneer of a permanent and a to-be-extensively-used class of tools? It requires, I suppose, some discrimination and some cool judgment to determine what is exceptional and temporary and what is to become regular and common in shop practice. Standard or average practice, as we know, is constantly changing, and we complacently assume that it is always advancing. In this it is more than possible to be too optimistic. There must be a selecting or a sifting going on all the while by which mistakes can be corrected and redundancies eliminated. There is a constant tendency when we make a start in a new direction to go too far. Just now the thing uppermost in the "practical" mechanical mind is the heavy or rapid cutting of steel or other metal, and we are hearing of lathes or other machines which come quite near to making a ton of steel chips or shavings in an hour. This is properly to be spoken of merely as a fact of the time and not with any suggestion of wonder or boasting, because of course we all know that it is just as possible to make machines able to cut double as much in the same time, or four times as much or any larger quantity.

The only question is as to how far it will pay to go in this direction. We must not forget that the increase in cutting capacity is to be regarded comparatively as well as in its absolute aspect. There are lines of manufacture which call for bigger and heavier pieces of metal in their constructions, and it is in the manipulation of these that the big cuts are made. The work has grown faster than the tools, and the tools have been racing to catch up. It may be that they have entirely caught up with the procession.

The general tendency of the trade in later years has hardly been in the direction to necessitate such heavy cutting or the removal at any speed of such great quantities of metal. We have been boasting that we could cast or forge nearer to finish dimensions than ever before, but we can do this thing no more, and now that we have to be making the big chips in turning shafts or other similar pieces we are not so much showing our ability as we are betraying our incompetency. We really ought not to have such big reductions of diameter to make, and the fact that we do make them "gives us away." It is quite a question how far we ought to compromise with the steam hammer or the hydraulic forging press. From the forging side of it and for the credit of that side we ought to be in position to boast of how light cuts would be required and not how heavy ones we could be compelled to make. It will hardly be claimed, I suppose, that these heavy cutting machine tools are the handiest and best for the lighter work, because the general experience of the trade is all against it. Of course if we have no more light cutting to do, or if we are going to do all our finishing with grinders, then the comparatively heavy cutters may be all right. If our general work does not call for and will not permit the heavy cutting for which such tools are made, and if it is only occasionally they can get a chance to show their strength, then why should they show it at all? A little time lost on the occasional heaviest work may be more than saved by the better time made on the general work.

I sometimes think that the special features which constitute the talking points or the selling points of the modern tools are often worked for more than they are worth, and that shops are loaded with tools possessing special features which are excellent but which seldom or never come into play where the tool is employed. A lathe which does not have a screw thread to cut once a month is not much helped by a handy arrangement for changing the lead gears or which gives the entire range of changes by the mere shifting of a lever. Taper turning attachments are serviceable for taper turning, but they are of no value, but just the reverse, on a lathe which never has any taper work to do.

It happens quite often that the new machines are not selected by the man of the establishment who has the best mechanical judgment or experience, but by the one who knows how to get the greatest value for the money. What he often gets is the most costly thing for the money, which may be very different from the thing that would be of the greatest value to the shop.

In shops of considerable size where there are quite a number of standard machine tools of each class—lathes, planers, shapers, millers, drills and the rest—it never happens that each of these tools is employed on a great variety of work. They each settle into their regular and narrow lines and rarely do anything else. For doing this precise work they should of course possess every possible facility, but what will it avail them beyond that to be able to do things that it will never be possible for them to get a chance to do. Most buyers of engine lathes would of course never think of buying a lathe without the full screw-cutting apparatus, and yet we know that as lathes go not one-quarter of them ever cut a thread. It is a good deal the same with the ability to make big chips; what's the use of it if you can't get any big chips to make? If an athlete is going in for a race or a slugger is going in for a fight, he always strips for it. We don't seem to be going in much for stripping our machine tools, yet why not? I suppose some day some machine-tool builder will arise with "nerve" enough to advertise that his normal lathe is the stripped lathe, adapted to do the plainest work and the most of it, and that the special features required will be furnished when they can be of use but are not recommended where they cannot be used. The cheapness that is secured by the discarding of the useless and the redundant is to be commended. It is well always to remember that the machine which can do the greatest variety of work can never do any of it as well or as rapidly as the special tool for the individual job. Ready-made tools after all are like ready-made clothing. They are made to fit anybody and everybody, but the custom tailor will tell you and show you that too many people don't know what a fit is.

TECUMSEH SWIFT.

Jigs and Fixtures in a Technical Course.

Editor American Machinist:

So much has been written on the subject of shop work for manual training and technical schools that I hesitate to add another line; and yet it seems to me the most logical course has not been outlined in the papers. There have been many letters of criticism, but few of actually helpful suggestions. One man complains that he was never taught to use a "size" scale, another that he could not figure pulley speeds, and a third that his training was ridiculously unpractical. At my own school none of these three faults was prominent, but I could easily find some other points to criticise, in the light of the experience that has come to me through practice. Before I finished my time as an apprentice in a machine shop, I came to the conclusion that there were a good many many things the school had not taught me. Right there is the point, too: don't we expect too much of the technical school? Its field must be educational, and still we complain if we are not taught all the "kinks" of a trade.

But that word "educational" has been most grievously handled. Advocates of a purely theoretical training appropriate it as distinctly their own; other teachers avoid its use as something dangerous, while incompetent men crawl behind it as a bulwark when their system is assailed. To be truly educational a manual training course must give a clear, specific idea of the best modern practice in machine shops—not necessarily going into minute details. If this is not done then the graduate is no better off than if he had served his apprenticeship instead of going to school, for he can learn the details and

"kinks" practiced in any *one* shop very thoroughly during his term of service.

Though infinitely superior to a course of "exercises," I do not think the practice of having each student make some complete machine—lathe, engine, clock, etc.—is admirable, because it is so widely at variance with good shop practice. Even a man who can "build an eight-day clock and make it run" might get lost in a clock factory while hunting for a drill jig and wondering what it looked like. I venture to say that there are few graduates, just out of college, who have an intelligent idea of jigs and their uses, and yet jigs and fixtures play an important part in modern manufacture. Their simplicity would seem to commend their use, especially in a student shop course. Consider, for example, the fluting of taps. In nearly every school sooner or later the student has a tap to make. He turns up the steel, threads it and flutes it, and has a tap—but what has he learned about tap making? Disregarding the jigs and special threading machines, we may take up the fluting. A fixture for the milling machines for fluting these in gangs is very commonly used by manufacturers. It is a simple tool, and easily drawn, hence would commend itself to beginners in the mechanical drawing class. From drawings first-year students in the shop could make the parts, and afterwards use the jigs to mill their taps. In making this one jig there would be exercises in planing, accurate drilling, gear cutting, turning of both cast iron and steel, and in thread cutting (we could introduce chipping and filing if advisable). In addition to this exercise the student will have learned what a jig is, its uses and limitations, and possibly will have gained an idea of how important a feature of jig design simplicity is.

I need not multiply examples. My meaning is clear I am sure. Any who wish to introduce jig and fixture design into their course can find for themselves cases wherein their design would require any degree of skill or judgment. ROY H. SMITH.

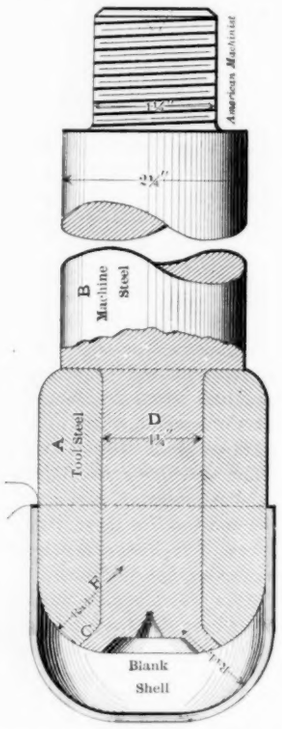
Punch for Drawing Large Shells.

Editor American Machinist:

The sketch shows a drawing punch for the drawing die shown by Mr. Woodworth at page 1338, Vol. 25. The punch *A* is made of tool steel, shaped as shown and countersunk at *C*. *B* is of machine steel reduced on one end *D* to fit *A*, with the end countersunk and riveted at *C*. The upper end is reduced and threaded to fit the hole in the press head.

The punches for the first and second operations are made in two pieces for the saving in cost of tool steel and labor, and because punch *A* can then be replaced without making an entire new punch.

From experience I find that a punch of this size made with radius *F* will do good work, giving the metal a chance to draw over a large surface. Sometimes the punch is made with a small radius; this I find is a mistake, as it draws the metal at the corner only. It in fact does not draw but only tends to tear the metal. Particular attention is called to the round at *G*; this forces the strippers open on the upstroke. Make *A* as hard as possible and, after hardening, heat a little to draw the spring or expansion. I do not mean to draw to the temper. All steel



PUNCH FOR DRAWING LARGE SHELLS.

after hardening has a strain in it which makes it very brittle with a tendency to chip and crack. By holding the steel over the fire until warm this strain leaves it. *A* is made with a slight taper to make the slipping easy. *B* is made from cold-rolled steel. The upper end is threaded to fit the press head. Some mechanics secure the punch with a set-screw, which is very unsatisfactory and is not positive. Nine out of ten times the stripping is harder than the drawing. The blank shell is shown after the second operation; the dotted line is the stripper.

Sizing Blanks for Drawing Shells.

Editor American Machinist:

Mr. Brown's article at page 63, on sizing blanks for drawn shells, I was for a while unable to understand, but on going over his tables I found he had used the rule I gave for combination die work, by which the diameter of the blank equals the diameter of the shell plus 1¼ times the hight.

It seems rather odd that so much should arise from so little, and as this argument arose from a simple statement that I had used quite a number of rules for obtaining the sizes of blanks for shell work, but did not consider them as reliable as weighing or trying for a blank. But, as such is the case, and as I am still of the same opinion, I feel that in justice to the editor and readers and also to myself, I am bound to prove my case if possible. And, as Mr. Brown did not seem to consider my previous article sufficiently to the point, I will endeavor to make it plainer in order that he may understand why I prefer to use the two methods he takes exceptions to.

In most of my work I endeavor to curtail the number of operations as much as possible without injuring the metal; consequently I often stretch the metal to a greater extent than I otherwise would, and also as the greater part of our work is very irregular, all the surfaces of the shell not acting the same under pressure, sometimes a peculiar shaped shell will elongate in the dies, sometimes shorten; the reasons for this are too well known among sheet-metal workers for me to dilate on that fact here.

Last but not least comes the matter of trimming. Up to a few years ago all our work was trimmed in a hand lathe (somewhat after the pattern of a speed lathe), sometimes with a circular cutter, but more often with a tool held in a tool-post on a small saddle and cross-slide, and as we were paying for this work on a piece-work basis, we endeavored to do as much as possible and do it as cheaply as possible, and finding that the rings left by a shell that was too long interfered with the operative, we decided to draw our shell the *proper length*, leaving just enough to trim without leaving a ring, and in order to do this we *weigh the shell or try for our blank*, as the case requires.

I might compile a table showing the *exact* sizes of blanks obtained by Mr. Brown's formula, but I believe one case will be sufficient. Take, for instance, a shell 1 inch diameter by 1 inch high; Mr. Brown gives 2.236 inches as the diameter of the blank to make the shell in one operation, using .020 inch drawing brass. Trial gives 1 31-32, which leaves about 3-64 for a trimming edge. Some will consider this to be somewhat extreme for a single operation, but I have exceeded it in some cases, and by experiment have found that I can often exceed it by one-half, but do not do so, as the strain on the press is too great.

I do not believe that a rule that works on steel shell work will give the same result on brass, or on any of the softer metals, and I do not expect to obtain the same results from tools made for steel that I would from tools made for brass, copper or german silver.

In regard to the shell referred to by Mr. Brown, I believe that his rule would work very well on that class of work, if the metal were not crowded in the tools, and the proper allowance made for reducing the metal; but I believe that I should have used the rule given by Mattituck, at page 240, as I have found that it

gives better results on that class of work than anything else I have used as yet.

Mr. Brown seems to consider trying for a blank quite a tedious and costly operation; he almost infers that the whole operation of making tools must be gone over again after the blank is obtained. I assure him that any one of our men will make a complete set of drawing tools for a shell up to 1x1 inch, try for and obtain his blank and turn over the tools in fifteen hours—and not half try, either.

W. W. Patterson.

"Experience."

Rapid Cutting of Metal—Why Don't it Get Hot?

Editor American Machinist:

Mr. Tecumseh Swift opens up a large subject in his article, at page 380, on "The 'True' Cutting of Metals," and one that is of the greatest interest. From the broad field that he includes in the term "cutting," we can see that there is very little work in the machine shop that does not include some branch of it, and it is certain that our knowledge of all the phenomena that accompany these operations, and the *whys* of them, is far from being as complete as might be desired.

One of the surprises I have had from high-speed steel is that it does not seem to generate the heat that would be expected from the rate at which it is run. In our work we turn up numbers of Bessemer steel shafts. The rate of cutting on these is well known and they were selected as being an easy job to make the tests on. Having in mind the trouble s metimes caused by a shaft expanding and doing damage to centers and bearings, I was very careful to watch the heat manifested in the shaft when testing the first lot of high-speed steel that we received, and I was very much surprised to find that the shaft was actually much cooler than I expected, and also much cooler than when using the usual steels and cutting at the regular rate. The cutting speed was increased until it was several times as fast as had been our practice without the heat becoming at all troublesome; in fact the shafts are often turned dry.

To be more specific: on a certain size shaft the usual time used to be about 3½ hours. In trying to find the limits of the steel we did one in 45 minutes. Without any particular effort to crowd things, six are now finished in a day, and the man doing them says they do not get as warm as they did when three were a big day's work. As there is the same handling to do in either case, and as comparatively little time is saved in doing it, it will be understood that there is more difference in the cutting speeds than the difference in time would indicate. The same thing is true of the work in cast iron. On straight work the speed is increased from two to three times with little, if any, increase in the temperature of the work.

It would seem that the actual resistance overcome in removing the metal could not be increased without its equivalent heat being made apparent. The extra amount of metal is removed, but the heat is not there. Granting this is true, the resistance has not been increased, or else the conditions for disposing of the heat are better. The tools used are of the same style as used with the other steel, but there is quite a difference in the shape of the chips. The chips cut at the high rate do not curl up nearly so much as they do at the slower rate. While there may be enough difference in the setting of the tools to account for some of this, still the element of time seems to have an influence also.

While for work requiring a very fine edge our high-speed steel may not be equal to the best grades of regular tool steels, in our work it will hold a better average cutting edge than tool steels. As this is very noticeable on cast iron, it would seem to uphold Mr. Swift's experience that such steel is superior in its punching qualities, but it is also true on soft steel. There is one thing that we find it is not good for, and that is, to take a slow, easy cut. It requires a certain amount of hard work to bring out its good qualities.

When ready to go into the lathe, it can be filed with an ordinary lathe file, and after running over a shaft and holding its edge, it can be taken out, and one stroke of the file will do more damage to it than the work did. While it is not soft when compared with a piece of iron, it is certainly soft when compared with a piece of tempered carbon steel. It acts under the file about like a cold chisel that would suit a skilled man.

It seems like an upsetting of the old landmarks to need to badly overheat a piece of steel, and then run it at an unreasonable speed, to bring out its best qualities; and then to find that it is soft enough to file seems to be rubbing it in a little, but facts are stubborn things.

While I am not interested in one high-speed steel more than another, as I believe they are all a great advance over any of the old self-hardening steels, it might interest some who like to verify strange statements to know that I have been using the "Capital." It is not used by us to put on a "water cut." Our men have not had much success with that kind of finish with the lathe on "filing" speed, which is our usual "finish cut." The limit on a light finish seems to be what the lathe will run, and not what the tool will stand. I have seen a cut run over a 3¼-inch shaft that was doing over 250 revolutions a minute. In this work that we do the cuts are not very deep. A 3⅝-inch rough shaft is finished to 3½ inches in a roughing and a finishing cut.

W. Osborne.

Size Blocks.

Editor American Machinist:

The set of size blocks illustrated at page 102 ought to be handy for any toolmaker. They remind me of a set I used in the toolroom of the Rue Manufacturing Company in Philadelphia, but it seems to me those were more convenient.

They were round (although this is not always an improvement), but the other feature was that they had a hole in the center of the same diameter as the thickness of the block. This was a very convenient feature at times.

Fred H. Colvin.

Synthetic Production of Alcohol from Acetylene

As our readers are already aware, Germany has developed processes for producing alcohol, chiefly from potatoes, at a cost as low as 20 cents per gallon, and is beginning to employ it extensively as a source of power. The chief deterrent to the more extensive use of alcohol is, however, still its cost, so that the statement that comes to us from United States Consul Haynes, at Rouen, France, of the prospect of reducing this cost of production by one-half is of the greatest interest. The French process is synthetic, and no vegetable product is required. Sufficient hydrogen is added to acetylene to produce ethylene, and in combining water with the ethylene alcohol is produced. The cost of production at present does not differ greatly from the best German results, but it is predicted that the cost will ultimately be reduced, according to figures given by Consul Haynes, to about 9 cents a gallon. The process as outlined, beginning with the production of the acetylene, is an intricate one, and it is interesting to note the collaboration of invention and discovery of which it is the up-to-date climax.

Examination for Engineer Draftsmen.

Examinations under the United States Civil Service Commission for the position of "engineer draftsman" are to be held in a number of designated cities on April 21, open to all citizens of the United States, graduates of a technical school, with one year's experience. Appointments from the successful applicants will be made in the office of the supervising architect of the Treasury Department at salaries from $1,400 to $1,600 per annum. Those seeking information should at once address the United States Civil Service Commission, Washington, D. C., asking for Forms 304 and 375 and a copy of the Manual. The exact title, "Engineer Draftsman," should be adhered to in the correspondence.

Theory Disproved Again.

In theory an equal force
Must be used to move or stop a thing.
But why, when two bells start a car,
Does it stop for just a single ring?

—*Buffalo Express.*

A subscriber would like the experience of our readers as to the practicability of packing square or hexagonal piston rods, of, say, 2 inches across the flats, against 100 pounds pressure.

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The Corliss Valve Gear.

The literature of the Corliss valve gear is one of the mechanical anomalies of the time. No mechanical device has been more widely adopted, and few, if any, have been illustrated and in a general way described in mechanical journals so many times. It is to-day a standard device, used and accepted as such throughout the world, and yet there is not in existence, so far as we know, a complete detailed critical study of it from the designer's standpoint, nor is there such a description of it as will enable a designer who is unacquainted with it to design it in a manner satisfactory to himself. Before the appearance of Mr. Begtrup's book on valve gears, there was, indeed, no treatment of it in print from the designer's point of view, and it is not a discourtesy to that excellent work to say that the compression necessary in such a book has resulted in the omission of much that is needed in a complete study of the gear. It is a literal fact that the existing knowledge of this device of world-wide use has been passed from hand to hand, from mouth to mouth and from engine to engine. Each constructor of the Corliss engine has begun by the study of existing engines or by obtaining the services of a designer who had had experience with the gear elsewhere.

Under these circumstances the articles by Mr. Moss, of which we publish the first in another column, fill a distinct gap in mechanical literature. From the geometrical side they give, we believe, a complete exposition of the properties of the gear and of the methods to be followed in order to obtain the best results with it. Moreover, the methods used are distinctly novel and form a sharp contrast with the rule of thumb methods which are still followed by too many designers. They will thus, we believe, be equally acceptable to the beginner and to the veteran designer in this field of work.

The Metric System in Spain.

In another part of this issue we print a letter from Spain bearing on the metric question, and as there stated we stretch a point to print this letter because the testimony we have heretofore been able to get from men who, in machine construction or in mechanical engineering work, have used both systems has been practically unanimous in favor of the metric system as the more convenient and efficient system for such work, and we want to publish both sides so far as possible. Undoubtedly, Mr. Ball's first proposition is correct, *i. e.*, it is not so much a question of the intrinsic superiority of the one system or of the other, but as to whether it is worth while to make the change. Of course this depends again upon how much the system it is proposed to take up is better than the one we now have. No person can possibly say how much, but the testimony we have been printing ought to help in forming some idea as to whether it is better at all or not, and, if it is, how much.

As to the throwing away of our present standards in adopting the metric system, we think no sane man acquainted with the art of machine construction or with mechanical engineering would dream that such a thing is possible. Yet we find eminent mechanics and engineers, men thoroughly acquainted with standards and fully appreciative of their importance, advocating the adoption of the metric system. This seems at first glance to be hardly believable, but upon investigation it is found that such men believe that it will be perfectly practicable to retain all our present standards that are worth retaining and to retain them so long as it is worth while to do so, and that the adoption of the metric system will not affect them at all. In other words, that our present standard taper shanks for tools, our Briggs standard pipe threads, our Sellers standard threads, our air-brake couplings, and so on through the whole list to our hats and shoes and collars can be and will be made to the same size after the adoption of the metric system as they are now, and that such standards will be discarded only when for good and sufficient commercial reasons it is advisable to do it; or, in other words, when by the adoption of different devices or methods it becomes as easy to adopt a new standard as to maintain the old one. There is to such men no force in the argument that exact equivalents in the metric and English systems are not obtainable because they know that exact standards in machine shops are now maintained by means of a tool which in many cases does not give an exact equivalent of the dimension sought but yet gives it within practical working limits—the exact decimal equivalent of 3-64 inch, for instance, being 0.046875 inch, which is approximated with sufficient accuracy by a micrometer reading, not to millionths of an inch, but to thousandths, or, for extra fine work, to ten-thousandths.

What Mr. Ball says about the confusion existing in Europe in the matter of screw-threads is familiar, and relates to a condition of affairs that efforts are being made to correct by the adoption of a standard thread based upon metric dimensions, and such a thread has in fact made some headway in machine construction, though it is stoutly maintained that if they had in Europe a screw-thread standard as satisfactory and as well established as our Sellers or Franklin Institute thread is here there would be no occasion to change it, and scarcely anyone would seriously propose doing it.

Whatever the real truth may be with regard to all this, we still stick to our original position announced several years ago, *i. e.*, that whatever steps may be taken by machine builders here in America toward the adoption of the metric system

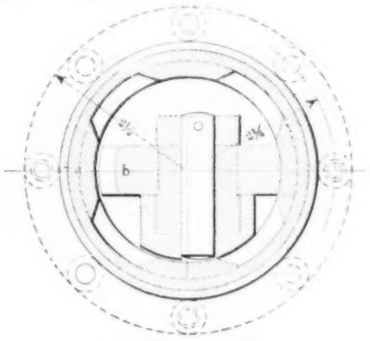
will be taken simply because such steps are, at the time they are taken, profitable and for no other reason whatever.

Some New Things.

AN INTERNAL WORM STEERING GEAR.

The engravings illustrate a new steering gear as built for runabouts and medium-weight vehicles, a heavier gear of a similar design being made for touring cars and heavy autos in general. This device is self-locking in any position, and is rapid in action, a three-quarter turn of the hand-wheel changing from straight ahead to hard over; that is, one and one-half turns give the connecting arm or lever its full 90-degree throw. The driving member of this gear, which is shown at *a*, and which, when in position, is connected with the hand wheel, is an internal worm—with quadruple thread—which meshes with a spiral gear *b*, the latter being mounted eccentrically to *a*, so that the teeth engage in the manner indicated at *C*. The stud on which gear *b* is placed, which stud is mounted, as shown, in lugs formed in the oil-tight casing *d*, enclosing the gearing and protecting it from dust, carries the arm *e* for connecting the steering apparatus, this arm being connected to *b* by a key, and to the steering knuckles by ball and socket joints. This steering gear can be attached to any style of vehicle. It is made by the Brown-Lipe Gear Company, Syracuse, N. Y.

R.H.		L.H.	
Internal Worm		Special Gear	
Pitch	8	Pitch	8
No. Teeth	4	No. Teeth	32
P. D.	3 1/16	P. D.	2.786
Angle	80 36	Angle	9 24
Lead	1.592	Lead	32.869



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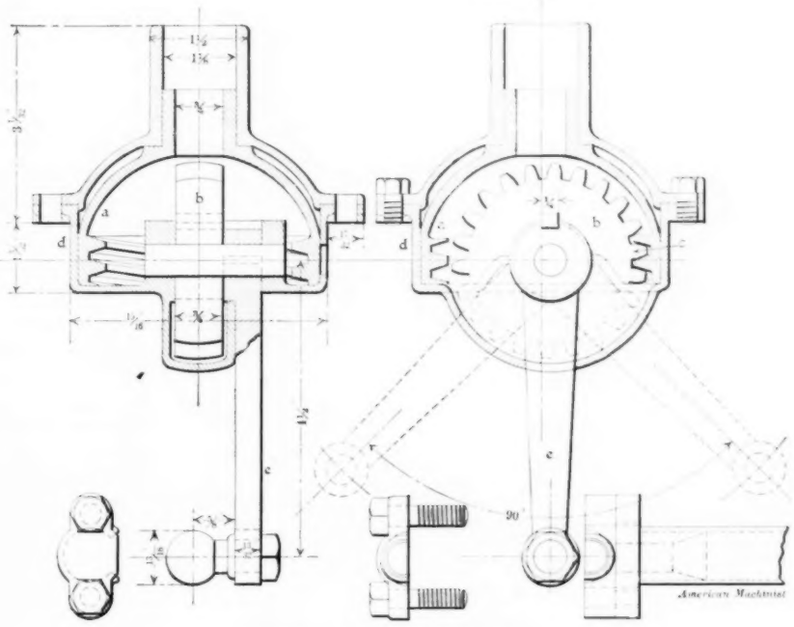
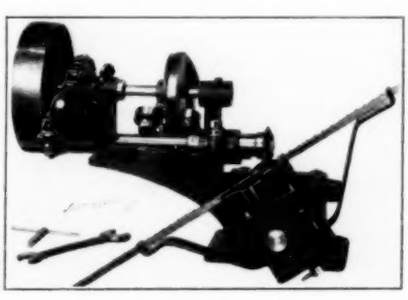


INTERNAL WORM STEARING GEAR.

SAW FILING MACHINE.

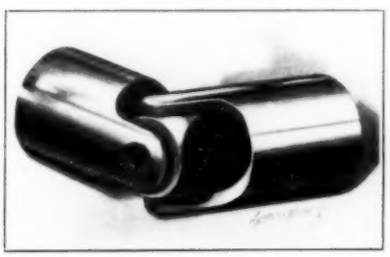
The half-tone shows a machine which is designed for filing hand, circular and band saws, suitable attachments being provided for holding various sizes of these different types of saws. This machine uses a circular file, this being mounted, as shown, on a shaft placed at the front and rotated through chain and sprockets by the driving shaft. The file shaft support is really a rocker arm which is given an up-and-down movement by a cam on the driving shaft, this cam actuating a lever which is connected to the rocker frame. The same cam also gives the file shaft a longitudinal movement. The file is formed with a smooth or uncut surface for about one-third of its circumference. When the file has made two rotations—which it does to each turn of the cam shaft—and the smooth portion reaches the saw tooth, it (the file) is lifted clear of the tooth, moved along one tooth and dropped into the following space and then moved back to its former position, drawing the saw along one tooth. Thus the file sharpens the tooth and performs the feeding operation. Provision is made for regulating the depth of the filing cut, the pressure of the file, and for accurately gaging the work. The attachments for holding the saws are adjustable so that the teeth may be filed at any desired angle. Various sizes and shapes of files are made to suit different classes of work; and any form of tooth can be filed provided the tooth is not over ½ inch in length. For filing larger sizes of circular saws a heavier machine is made, this being adapted for sharpening 1-inch teeth. The Rotary File & Machine Company, Brooklyn, N. Y., are the builders.



SAW-FILING MACHINE.

UNIVERSAL JOINT.

In this joint the central member, to which the two sockets or heads are pivoted and which is made in halves and hardened, is drilled through from the outer face of one-half to the opposite face of the other to receive the body of a shoulder screw, the head of which fits, as shown, in an ear on one socket or head while the threaded end is tapped into the opposite ear. For connecting the central block and the other member of the joint the latter is provided with two studs or pins (formed with heads) which are fastened securely in the ears and which turn freely in pockets formed in the blocks. The inner parts of the joint are oiled through a hole drilled, as shown, in the shoulder screw. To shorten the ears as much as possible, the metal between them is swept out, leaving the surface which has to clear the corners of the swivel block concave. This joint is made by the Mutual Machine Company, Hartford, Conn.



UNIVERSAL JOINT.

DRILLING AND TAPPING MACHINE.

The engravings illustrate a recently designed drill and tapping machine, in which the reversing mechanism for the chuck is

carried in the spindle sleeve moved up and down in the head by rack and pinion. The arrangement of this mechanism is clearly shown in Fig. 2. The upper spindle

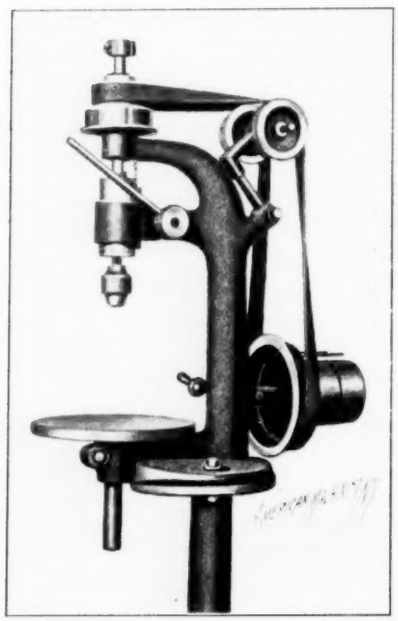


FIG. 1. DRILLING AND TAPPING MACHINE.

A, which is provided, as shown, with a ball thrust bearing, terminates in a gear *B*, which meshes with the in-

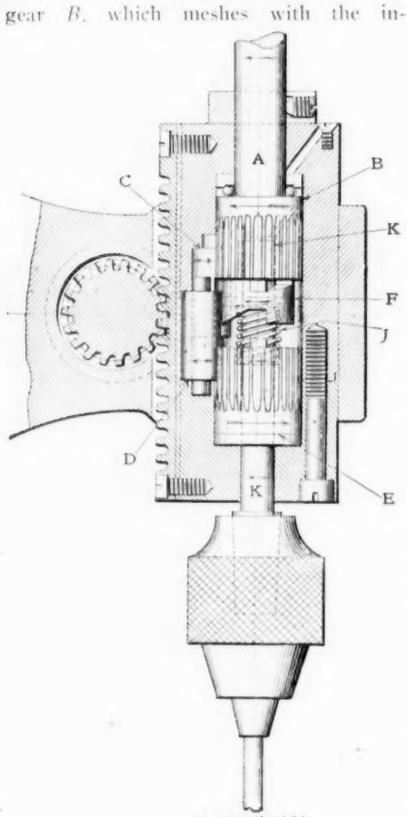


FIG. 2. SPINDLE MECHANISM.

termediate pinion *C*, driving pinion *D*, the latter in turn imparting a constant reverse rotation to the lower gear *E*. The lower spindle *K* has a bearing in the sleeve, in the lower gear *E*, and also in gear *B* at the end of spindle *A*, thus preserving the alinement. The clutch *F* on spindle *K* is held in contact with the clutch teeth on gear *B* by the spring *J*, thus ordinarily causing *K* to rotate with *B*. When tapping, a stop is set on the upper spindle which arrests the downward movement of the sleeve, thus causing the tap to draw the lower spindle down and free the clutch. Then, with a light upward pressure on the hand lever, the clutch will engage with gear *E* and the tap will be backed out. This machine will drive taps up to ¼ inch and can be made with several spindles if so required. The Murray Manufacturing Company, Richmond Valley, Staten Island, N. Y., are the makers.

Technical Publications.

"The Steam Turbine." By R. M. Neilson. 163 5½x8½-inch pages with 145 illustrations. Longmans, Green & Co., London and New York. Price, $2.50.

Existing literature on the steam turbine is mainly of the descriptive class, whereas this book is essentially a treatise. It is, however, descriptive as well and, in fact, goes into details of construction more fully than has been customary. The theory of the action of the steam is explained, as is the thermodynamics of the motor. A chapter is given to the results of tests of turbines.

"Die Gèblaese: Bau und Berechnung der Maschinen zur Bewegung, Verdichtung und Verduennung der Luft" (Blowers: Construction and Calculation of Machines for Moving, Condensing and Rarefying of Air). By Albrecht von Ihering, Kaiserlicher Regierungsrath, Member of the Imperial Patent Office, Dozent in the Kaiser Friedrich Wilhelm University at Berlin. 752 pages, 6x9 inches; 522 illustrations in text and 11 tables. Berlin: Press of Julius Springer. Price, 20 marks.

As the author himself points out, the chief title of this work—"Blowers"—is inadequate to describe its contents, which are better indicated by the sub-title. The book is divided into two parts, the first a "descriptive" one (in the mechanical, not the catalog sense), comprising chapters on piston blowers, air compressors, air pumps, rotary piston blowers, centrifugal fans or ventilators, helical blowers and jet blowers. The second portion is devoted to theory, which is studied so far as possible in terms of the lower r athematics. Periodical literature has been drawn upon to furnish results of experiments, etc. The first edition of this work was published ten years ago, and the present one is considerably revised. In bringing the subject up to date old matter has been omitted and new added. Among the topics introduced are blast furnace gas blowing engines; hydraulic compressors; new compressors with spring valves, piston-valve gears, etc., and improvements in condenser air pumps. The added subjects among ventilators comprise particularly the steam-turbine-driven device of Rateau and the Davidson and Mortier inventions. The book is one of eminently solid and serious character.

Among the papers read at the March meeting of the British Institution of Mechanical Engineers was one by Mr. James Rowan, of Glasgow, on "A Premium System Applied to Engineering Workshops," in which were described the methods used at the marine engine works of David Rowan & Co.

Engineering of March 13 contains illustrations and a description of the National (British) Physical Laboratory. The standard measuring machines are shown in a basement room, the walls and ceilings of which are of rough brick work, full of deep crevasses in which dust can, and of course will, collect. It is scarcely conceivable that the man who has charge of these machines chooses to have them in such an environment.

Captain Mahan in the *Atlantic* for March speaks somewhat derisively of a seaman who in navigating a ship carried out the calculated definement of her position to the hundredth part of a mile. We often hear derogatory remarks about the minuteness of the results obtained in shop or drawing office computations, but almost invariably they are undeserved. In working with decimals, as we always do in such work, the results come out with many figures to the right of the decimal point, and it is a question of taste rather than of accuracy as to how many of them shall be retained. As a general practice computations are not made with any too great minuteness. It is not in stating the results but in the after use of them that judgment is required.

We note that Sir Thomas Lipton has suggested, and that it is proposed to have, some old-fashioned steamboat races at St. Louis during the exhibition, and the Department of Publicity is talking about boats going down the river "with fire belching out of the smokestacks and the boats going forward at a terrific rate of speed." This is all well enough, but when the boats were doing tricks of that kind, it was not announced beforehand that they were going to do it, and there were usually no inspectors, nor anybody else to restrain the ardor of captains, engineers or firemen, who, if all stories are to be believed, used to pack hams, side-meat, or anything else that would make steam, into the furnace, at the imminent risk of blowing up the whole business. It is not likely that the steamboat races to be held during the exhibition will be carried on under such conditions, and while they may be interesting enough, we doubt if most

people would find in them the element of excitement that used to attend the old-time Mississippi steamboat races.

The American Institute of Electrical Engineers has arranged for the enrolling of students in electrical engineering as students of the Institute. The enrollment, which is limited in time to three years, costs but three dollars a year. This sum entitles the student to the privilege of attending all meetings, except business meetings, to printed copies of the monthly Transactions and to the semi-annual volumes of Transactions at a reduced price. The Institute has also undertaken to establish local or branch meetings. The papers presented at the New York meetings will be presented and discussed at the ensuing local meetings, together with additional papers by local members.

There died recently in his ninetieth year, at Stalham, Norfolk, Mr. R. Middleton, who was first to introduce the threshing machine in his county, and had for a time to bury the innovation in pieces in his garden on account of the riots it caused.—*The Engineer.*

Personal.

W. H. Hattel has gone into the business of general patternmaking at Water and Rose streets, Kalamazoo, Mich.

Information is wanted by the editor regarding the present address of William Salmond, a machinist, formerly of Dundas, Ontario.

Jos. F. Pflum, formerly with the Bickford Drill & Tool Company, is now with the Cincinnati Butchers' Supply Company, of the same city, as superintendent of iron and machine department.

Gustav Wagner, of Reutlingen, Germany, interesting examples of whose cold sawing machines we have published accounts of in our columns, is at present here, arranging for the manufacture of his machines in America.

Our contributor, A. J. Strong, has resigned his position as head of the tool-designing department of the National Cash Register Company to take a position as traveling salesman for the Pattern Tool & Supply Company, of Dayton, Ohio.

Arthur M. Waitt has resigned as superintendent of motive power and rolling stock of the New York Central & Hudson River Railroad. It is understood that he will take a well-earned rest after having been connected with the Vanderbilt lines for the past fourteen years.

W. L. Miller has resigned as secretary of the American Turret Lathe Manufacturing Company, Warren, Pa., and accepted a position as designer for the J. Morton Poole Company, of Wilmington, Del., who will place a line of heavy vertical boring mills and other machine tools on the market.

Commercial Review.

NEW YORK, Monday, April 6, 1903.

April has opened in the machinery market under the same favorable conditions which have prevailed during the past few weeks. Buyers are making their appearance in the machinery district more frequently, and even where they do not purchase, the inquiries they make, and the assurances they give, denote some excellent orders for equipment later on.

The announcement of the Southern furnaces that they will sell pig iron in the Eastern markets for the second half of the present year at $1 per ton cheaper than formerly, forms a most interesting development in the pig-iron situation. The furnaces state that the reduction has been made to meet European competition, especially from Germany.

For some time past makers in Germany have found American manufacturers, especially on the seaboard, their best customers. This is because they have turned out a grade of iron which has sold in this vicinity at from $20 to $21.25 per ton, and which they have claimed is just as good as Southern No. 2 foundry, for which $21.75 to $22.50 has been demanded in this market. Whether or not this claim is a fact, need not be considered now, but at any rate they have effected the sale of a heavy tonnage of the particular grade in question in this market.

Opinions differ as to whether or not the action of the Southern furnaces will serve the purpose for which it is intended. Much will depend on the response the German manufacturers will make, and they have not been heard from. Latest cable advices declare the pig-iron market in Continental Europe to be stronger than it has been in months, and prices for foreign irons are now considerably higher than they were at the beginning of the year. How long this state of affairs will continue is uncertain, but it is noteworthy that the views thus far expressed bear a pessimistic flavor.

One of the principal factors in the matter is the probable increase in pig-iron production in America during the coming year, and which latest reports declare will amount to at least 2,000,000 tons. Will the demand be in proportion? is a question frequently asked in iron and steel circles. The answers given all agree that it is a matter of conjecture at best, with opinions inclining to the affirmative.

It would seem, therefore, that the relation which consumption will bear to the increased production, will determine the course of pig-iron values for the coming year. Last year was a banner year for the iron and steel industry in America, and yet our imports of pig iron only amounted to 550,000 tons. Assuming that the next twelve months will be equally as good, will we be able to find use for the 2,000,000 increased pig-iron tonnage we will have? If we figure that in 1902, when prosperity in the iron and steel industry, admittedly attained the greatest proportions ever known, we were compelled to import only 550,000 tons, it would seem, to say the least, that well might foreign furnaces look with apprehension on the outlook for their trade in this country during the coming year, in face of the facts we have noted.

At any rate, the Southern furnaces have acted wisely in doing away with a prohibitive price for their product in this market.

We had occasion recently to state that engine builders were frequently confronted with delays in getting orders, even after their bids had been passed upon favorably. That some of those who pursued this policy have had occasion to regret it, is proven by the almost pitiable pleas which have been made to hurry delivery after the orders were given.

We have had our attention called to the experience of a certain New Jersey manufacturer who wanted two engines, and who had informed the representative of a certain engine company that he was perfectly satisfied with the proposition he had made him as to terms. This manufacturer was then informed by the engine man that he had better give his order at once, as deliveries on engines were not even satisfactory to engine builders themselves and of course not to their customers either. The manufacturer, however, flickered a smile which didn't need a phrenologist to interpret as indicating that he thought the statement a "bluff."

All of a sudden the manufacturer's old engines began to get out of gear, and repair them as he would, they did not give satisfaction. Then it occurred to him that he had better give the order for the new engines, and expected that he would have them delivered in a few weeks. Much to his surprise, however, the engine builder informed him that the best he could do was two months, and even at that intended to put himself to some inconvenience to oblige him.

Then the manufacturer waxed eloquent as to the large number of orders he had on hand, and that dire things would happen his business if he didn't execute them in a certain time. Finally he gave the order for the engines. Out in that manufactory to-day there is an engineer who has troubles of his own; a superintendent who is constantly besieged about when he can deliver "the goods," and a manufacturer to whom the installation of two new engines, will afford joy akin to that which is said to prevail in Heaven when even one sinner does repentance.

In our last issue we alluded briefly to real estate investors and speculators, being busy getting options on property now occupied by machinery men on Dey, Cortlandt and Liberty streets, between Broadway and West street.

We are now informed, on very reliable authority, that the Western Union Telegraph Company is negotiating for the pur-

chase of the building at 14 Dey street, at present occupied by J. J. McCabe, the well-known machine-tool dealer, and that the deal is likely to be closed any day, although the company may not take possession of the property in case it purchases it, for about a year.

On the streets we have mentioned are many buildings which not only bear the imprints of time, and whose usefulness is fast terminating, but which in addition are wholly at variance in every way, with structures in close proximity to them. Events of the past few months seem to indicate the demolition of these, and the erection instead of buildings approaching the "sky-scraping" class. We venture the assertion that a visit ten years hence, at the latest, will witness such a transformation along this line, as to startle those familiar with the present aspect of the district.

Because of what we have said, we would advise all machinery men who are located on the streets we have named, and who are satisfied in every way with the places they now occupy, to obtain a lease for as long a period on them as they can. We have in mind, of course, not those buildings which have been erected during the past few years, but those which first saw the light of day many years ago, and whose present appearance is the best evidence of the fact. There are a few such.

The Sterlingworth Railway Supply Company, of Chicago, Ill., has expended, during the past four months, some fifty-five to sixty thousand dollars in improvements to their rolling-mill department, consisting of gas convertors, a 100-ton gas furnace, 800 additional horse-power Berry boilers and 1,200 horse-power Corliss rolling-mill engine, and a full equipment of steel rolls for the manufacture of angles, I-beams and channels up to 15 inches.

Deere & Co., of Moline, Ill., have, at the end of a seven months' trial of the Nernst lamp, manufactured by the Nernst Lamp Company, of Pittsburgh, found this illuminant so superior to the arc and incandescent lights, that the latter are being displaced as rapidly as is consistent with shop practice. The large machine shop of this company, completed last July, is lighted by multiple glower Nernst lamps, giving greater satisfaction than the former system of local unit lighting. It is the intention to light the entire establishment with Nernst lamps. Another Deere interest, the Velie Carriage Company, of Moline, Ill., was led by observing the above trial to install in its plant a complete Nernst system, using a hundred lamps of the three and six glower types.

An indication of the development of the Canadian Northwest, in the manufacturing line, was the recent placing of orders for machine tools by a new concern, the Manitoba Iron Works, who are building a machine shop and foundry in Winnipeg, Man. They have purchased tools to the amount of some $20,000, nearly the whole equipment being placed by Burridge & Cooper, machinery dealers, of Winnipeg. The manner in which immigration is pouring into this part of Canada is making a demand for local machine shops and creates a good demand for equipment for small shops, a good many of which are already developing into manufacturing in a small way.

The Stanley Electric Manufacturing Company has sold to the Indianapolis & Southern Railway Company the following apparatus: Forty-eight type No. 402 railway motors, one 500-kilowatt revolving field generator, one 300-kilowatt rotary converter, three 110-kilowatt and three 150-kilowatt transformers and the necessary switchboard apparatus.

The new officers of the Stanley Electric Manufacturing Company, of Pittsfield, Mass., elected at the recent meeing of the Board of Directors are as follows: President, W. Murray Crane, Pittsfield, Mass.; first vice-president, Dr. F. A. C. Perrine, Pittsfield, Mass.; second vice-president, M. D. Barr, New York; third vice-president, S. N. Hammill, New York; treasurer, W. W. Gamwell, Pittsfield, Mass.; assistant-treasurer, R. S. Murray, Pittsfield, Mass.; secretary, W. S. Westover, New York; assistant secretary, A. G. Davis, New York.

The J. Morton Pool Company, of Wilmington, Del., inform us that hereafter they will manufacture a line of heavy boring and turning mills, and other machine tools.

Mr. Percy S. Davis, one of the directors of the Davis Calyx Drill Company, has returned from a prolonged business in Australia. On the way back, Mr. Davis stopped at Sonora, Mexico; Virginia City, Nevada, and a number of other localities where the Davis drills are in operation.

CHICAGO MACHINERY MARKET.

The impression among the electrical machinery people in the West seems to be that business is a little quiet compared with what it has been for many months past. Nevertheless, when the actual business closed is considered, it foots up a goodly amount. New inquiries for street-railway work are not so numerous, but there is much work of this kind under way and it will require a long time for contracts lately undertaken to be completed. Of shop work, also, there is quite an amount of business floating about, with probably some decrease, when compared with the splendid business booked in January and February.

The Rock Island road has bought a 600-kilowatt generator for the new shops to be erected at Moline, Ill. The order is said to have been secured by the General Electric. The motors for the shops, it is understood, have not yet been sought. The St. Paul Foundry, St. Paul, Minn., has bought a number of motors, in addition to an equipment previously installed. The Aultman-Weiborg Company, paint makers, Cincinnati, Ohio, has purchased a 500 horse-power generator with corresponding motors with which to equip its plant. The Pana Coal Company, Pana, Ill., has contracted for two 150 horse-power generators and engines to operate its plant electrically. The Standard Motive Power Company, manufacturer of automobiles, Canal Dover, Ohio, has bought a 1,500 horse-power plant with which to operate the works electrically, the motors not yet being installed.

The Illinois Malleable Iron Company, Chicago, will install a 175-kilowatt generator with complement of motors. Rueckheim Bros. & Eckstein are erecting a factory building at Peoria and Halsted streets, Chicago, and will equip the same with a 200 horse-power generator, motors to correspond. Fritz Foltz, architect for Col. Henry Dupont, Baltimore, Md., is erecting a building at Halsted and Twenty-second streets, Chicago, in which will be installed a 300-kilowatt generator and motors of corresponding power. The Brooks Company, printers, Cleveland, Ohio, will equip its entire plant electrically. The Denny Envelope & Tag Company, Chicago, will equip its plant electrically.

The Kruse Heating & Ventilating Company, Milwaukee, Wis., which has the contract for ventilating the Chicago postoffice, has ordered $20,000 worth of Sprague motors for driving the blowers and exhaust fans. The Evening News Association, Detroit, has also bought Sprague electrical motors, with which to operate its stereotype plant.

The Kilby Manufacturing Company, Cleveland, Ohio, has bought motors of 560 horse-power from the Crocker-Wheeler Company. Other recent sales of the latter company include motors of 310 horse-power and one 225-kilowatt belted generator to the Allis-Chalmers Company; motors of 195 horse-power to Armour & Co.; a 40-kilowatt belted generator to the National Malleable Casting Company, Chicago; a 22½-kilowatt belted generator to Chase & Sanborn, Chicago; and motors to the Champion Chemical Works, to S. H. Harris and to the Pacific Coast Borax Company, all of Chicago.

Quotations.

NEW YORK, Monday, April 6.

New York prices for Northern and Southern irons for the first half of 1903 are as follows:

Northern:	
No. 1 X	$23 25 @ $24 75
No. 2 X	22 00 @ 22 75
No. 2 plain	21 00 @ 21 75
Southern:	
No. 1 Foundry	23 25 @ 23 50
No. 2 Foundry	22 25 @ 22 50
No. 3 Foundry	21 50 @ 22 50
No. 4 Foundry	20 50 @ 21 50

Bar Iron—Base sizes—Refined brands, mill price on dock, 1.95c. upward in carload lots. Smaller quantities from store, 2.15 @ 2.30c.

Tool Steel—Base sizes—Good standard

quality, 7c.; extra grades, 10c. and upward.

Machinery Steel — Base sizes — From store, 2.10 @ 2.25c.

Cold Rolled Steel Shafting—2.90c. from store for base sizes.

Copper—Lake Superior ingot, 14 @ 14½c.; electrolytic, 14 @ 14½c.; casting, 13⅞ @ 14¼c.

Pig Tin—In 5- and 10-ton lots, f. o. b. New York, 29.40 @ 29.50c.

Pig Lead—4.67½c. in 50-ton lots.

Spelter—5.50 @ 5.70c.

Antimony—Cookson's, 8½ @ 8⅞c.; Hallett's, 6¾ @ 7c.; other brands, 6½ @ 6¾c.

Lard Oil—Prime City, 85 @ 87c., according to brand and quantity, ranging from one barrel up to large lots.

Manufacturers.

The Malden (Mass.) Electric Company is to enlarge its plant.

Lincoln, Ill., is trying to secure shops of the Chicago & Alton.

Work has begun on the site of shops of the C., R. & M., at Peru, Ind.

The Penn Mirror Company, Pittsburgh, Pa., may move to Morgantown, W. Va.

The Muncie (Ind.) Wheel Works will be enlarged to manufacture automobiles.

The Baumann Rubber Company, New Haven, Conn., is about to enlarge its plant.

A. Bruner & Sons, of Napoleon, O., hoop and stave manufacturers, will build in Tiffin.

The National Nut & Bolt Company has taken out two building permits in Pittsburgh, Pa.

The Bateman Company, manufacturer of implements, Grenloch, N. J., will build a foundry.

A boiler plant is being erected at the shops of the Jeannesville (Pa.) Iron Works Company.

The Nichols Chemical Company, New York city, will rebuild its big plant at Laurel Hill, L. I.

The Taylor Iron & Steel Company, High Bridge, N. J., contemplates enlarging its plant.

The plant of the Newman Lumber Company, Hattiesburg, Miss., has been partially burned.

The S. O. & C. Company, manufacturer of eyelets, etc., Ansonia, Conn., is building an addition.

The Damascus Nickel Steel Company is starting to enlarge its plant at East Carnegie, Pa.

The Florence-Portland Cement Company, Florence, Colo., will build a 1,000-barrel-a-day factory.

Broome County, N. Y., may erect a heating and lighting plant for public buildings at Binghamton.

A mill of the Ironton (O.) Lumber Company has been burned, but will be rebuilt on a larger scale.

Rock Island Railroad shops to be built in East Moline, Ill., will cost $800,000 for the buildings alone.

The Centrifugal Windmill Company, Ltd., Guelph, Ont., is to have a new factory building, 42x100 feet.

A large plant of the Hayden Furniture Company, Rochester, N. Y., has been burned, but will be rebuilt.

The York (Pa.) Manufacturing Company will add a new drafting room with improved blueprint department.

The plant of the Anderson (S. C.) Mattress & Spring Bed Company, which was burned, will be rebuilt.

The Oliver Typewriter Company, Chicago, is to have a 250x80-foot addition to its factory at Woodstock, Ill.

The shops to be built by the Pennsylvania Railroad at Enola call for engines aggregating 1,200 horse-power.

The Leavitt Machine Company, Orange, Mass., is planning to build an addition of 50x40 feet, three stories.

L. E. Armstrong, Fort Dodge, Ia., intends to organize a stock company for the establishment of a gypsum mill.

A new mill building is about being erected for Hughes & Patterson, of the Delaware Rolling Mills, Philadelphia.

A 76x150-foot, three-story factory building is being erected for the Cleveland (O.) Dental Manufacturing Company.

A building permit has been taken out for a machine shop for the Robinson-Tilton Machine Company, Columbus, O.

The Pekin (Ill.) glucose plant of the Corn Products Company will be enlarged. Starch works may be built this year.

The S. A. Williams Lumber Company, Chattanooga, Tenn., is about erecting a factory. The specialty will be hard woods.

Plans have been prepared for a machine shop and warehouse building, 60x105 feet, for Stevenson & Co., Baltimore, Md.

The Roddis Veneer Company, of Marshfield, Wis., has acquired a 36-acre site at Park Falls and will build a factory.

A factory building, 56x90 feet, two stories, is about to be erected by the Harp O' Chord Manufacturing Company, Columbus, O.

The Buckeye Screen Company, of Toledo, O., and elsewhere, is investigating Chester, Pa., as a location for an Eastern plant.

The McNab & Harlin Manufacturing Company, steam fitting goods, has land for a new foundry at its plant, Paterson, N. J.

The Bessemer Gas Engine Company, Grove City, Pa., is about to enlarge a foundry building leased to the Bessemer Foundry Company.

The Matthias-Wagner Company, Cedar Falls, Ia., manufacturer of weather strips and barn door latches, proposes to build in the fall.

Plans have been drawn for a factory for Schilling, Wandling & Co., Washington, N. J. We understand that they will manufacture clocks, etc.

O. F. Pirkey and F. M. Stover, of Strasburg, Va., propose to establish a factory for fruit crates and fruit baskets, probably at Baldwin, Ga.

The Passaic Steel Company, Paterson, N. J., has awarded contracts for two open hearth furnaces. The intention is to install ten furnaces.

New furnaces and machinery are to be added to the Oswego, N. Y., plant of the Railway Steel Spring Company, about doubling the capacity.

One or more factory structures are about to be built for the Wright Manufacturing Company, manufacturer of brass specialties, Philadelphia.

A 580x120-foot factory apartment building is planned for West Allis (a suburb of Milwaukee, Wis.) by the Northwestern Heat, Light & Power Company.

The N. & G. Taylor Company, of Philadelphia, lessees of the plant of the Maryland Steel Company at Cumberland, Md., will make improvements.

Capitalists, headed by George D. Dobbins, South Bethlehem, Pa., have acquired a property in the vicinity, which they will turn into a hosiery mill.

A meeting of malleable iron interests is set down for some time this month, at which a combination of that industry throughout the country is to be discussed.

The Reed Implement Company, capitalized at $150,000, has broken ground for a plow manufacturing plant at Battle Creek, Mich. Benjamin Watkins is chairman.

The contracts have been let for new buildings to be erected at a cost of $70,000 for the Reed Manufacturing Company, Newark, N. Y., manufacturer of tinware.

A permit has been issued to the Gorham Manufacturing Company, silversmith, Providence, R. I., to erect a three-story, 54x256-foot factory building with annex.

F. Feikel, C. E. and architect, No. 419 House Building, Pittsburgh, Pa., is receiving bids for building and equipment of the new foundry of the Eagle Foundry & Machine Company, in Allegheny City, Pa.; building to be 77x143½ feet, 36½ feet high, under roof trusses, with 20-ton and 5-ton traveling cranes, both arranged so as to run out of the building and across flask and stock yards. It will be of brick and steel and have steel-concrete platform and fireproof cupola-house.

The Western Electric Company, Chicago, Ill., has bought 109 acres of land at that place and will erect buildings to cost $1,200,000, exclusive of equipment. Plans have already been made for cable factory buildings with an aggregate floor area of about 1,50,000 square feet and for a large machine shop and iron foundry. The present capacity of the power plant will be 4,000 horse-power, and the works will employ about 1,200 hands. This undertaking will not curtail the present interests of the Western Electric Company. The company has invested $3,000,000 in buildings at its principal site on the West Side, and is laying out $500,000 on the Polk street tract. This is outside of the cost of machinery and equipment.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Grant. Gears. See upper corner, page 62.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks., Waltham, Mass.

Patterns.—Cincinnati Pat. Wks., Cincin., O.

Dies and Diemaking, 100 pages $1.00, post paid. J. L. Lucas, Bridgeport, Conn.

Working drawings which are working. Geo. M. Mayer, M. E., Monadnock, Chicago.

Wanted—Improvements in grinding machinery. Address Box 1435, Providence, R. I.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Automatic machinery designed and constructed by the Wellman Sole Cutting Machine Co., Medford, Mass.

Exper designing; industrial machinery; cost account systems installed and maintained. F. W. Brady, Englewood, N. J.

Wanted—Lathe, about 14x6; state make and length of time used. G. M. Deane, Cadiz st. and River, New Orleans, La.

Wanted—Competent managers, superintendents and foremen. James Brady, Room J, 20th Floor, 220 Broadway, New York.

Wanted—Second-hand gear cutter to cut gears from ¼ in. to 4 in. in diameter; state make and condition and whether automatic. Box 139, AMERICAN MACHINIST.

Wanted—Short contributions by practical power plant engineers for a publication for

steam engineers; illustrated when possible. Technical Publishing Co., Burns Bldg., Detroit, Mich.

Wanted—Manufacturer to build a patented machine with established trade; shop must be equipped to turn out highest grade of work. Reply, stating equipment, to Box 132, AMERICAN MACHINIST.

For Sale.

An attractive machine foundry blacksmith shop, in Lake Superior region, for sale. Address Box 149, AMERICAN MACHINIST.

A new drill drift; always ready; self-contained; quick acting; no hammer needed; low price. Maria Stein Mch. Wks., Maria Stein, O.

For Sale—Branch of machine tool line, well established 9 years, with domestic and foreign agencies, separate catalogs, etc., in machine tool center of the West; object, specializing. Address "Chance," care AMER. MACHINIST.

For Sale—Blacksmiths' Magic Welding Compound; welds all grades of tool steel like iron; buggy springs; restores burnt steel for cutting edge tools; receipt, with full directions, for $2.50. Address Box 68, Mullan, Idaho.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. State mentioned indicates present address of advertiser.

Situations Wanted.

FLORIDA.

Young man, 25, patternmaker and draftsman, wishes to change; prefer position in drafting room of a Northern or Western company. Box 135, AMERICAN MACHINIST.

ILLINOIS.

A young toolmaker, with technical education, as master mechanic or assistant superintendent; experience in designing. Box 134, AMERICAN MACHINIST.

NEW JERSEY.

A position as superintendent or chief draftsman desired by young man, 30, with technical education, practical shop and drawing-room experience; references; New York or Newark preferred. Box 145, AM. MACH.

NEW YORK.

Machine designer, etc., wants position. Address Box 63, AMERICAN MACHINIST.

Wanted—Position as cost accountant; experienced and well recommended. Box 110, AMERICAN MACHINIST.

Practical, executive man on interchangeable work desires position in New York or vicinity. Address Box 133, AMER. MACH.

Draftsman, technical graduate, with 2 years' shop, 4 years' drawing-room experience, desires position. Box 138, AM. MACH.

Frenchman (24), mechanical engineer, shop experience, wants position anywhere; speaks English and German. Box 141, A. M.

Mechanical draftsman, college graduate, 2 years' experience in drawing room and 3 years in shop, wishes position. Box 137, AMERICAN MACHINIST.

Wanted—Position as foreman with reliable concern; varied experience; can handle help profitably and is a thorough mechanic. Address "O. K.," AMERICAN MACHINIST.

General foreman, responsible man, up-to-date mechanic, experienced in high-class automatic and interchangeable machinery, is open for engagement. Box 128, AMER. MACH.

A young man of ability and experience, who is familiar with general office work, also cost system of factories and machine shops, desires a situation. Address Box 140, AM. M.

Expert stenographer, thoroughly familiar with office work, mechanics, drawings, etc.; first-class references as to energy and ability from former employer. Box 152, AM. MACH.

Position wanted by experienced designer and draftsman; jigs, fixtures, special machinery and machine tools; inventive and practical; several years in shop as machinist and toolmaker; New England preferred. Box 146, AMERICAN MACHINIST.

OHIO.

Wanted—Situation as superintendent of machine shop, by a man with practical experience in modern methods and discipline. Address Box 147, AMERICAN MACHINIST.

PENNSYLVANIA.

Mechanical draftsman, technical graduate, wants position in automobile factory in Middle West. Box 136, AMER. MACHINIST.

Young mechanical engineer wants position as designing draftsman; steam or gas engine work preferred. Box 150, AMER. MACHINIST.

Wanted—Position by a practical foundry foreman on heavy stationary or marine engines or jobbing; a man you don't need to watch. Box 142, AMERICAN MACHINIST.

Young man (24) would like position with manufacturing concern; have had 3 years' shop experience, 4 years drafting and general engineering; salary $1,100; best references. Box 144, AMERICAN MACHINIST.

Help Wanted.

CANADA.

Wanted—Four first-class screw machine operators; state wages expected and experience. Box 148, AMERICAN MACHINIST.

Wanted—First-class mechanic as speed boss; one who is thoroughly familiar with the capacity and the rate of speed at which all kinds of machine tools should run and the maximum cut they could take; must be thoroughly posted on modern and up-to-date methods. Apply to Canadian General Electric Company, Limited, Peterborough, Canada.

ILLINOIS.

Wanted—Superintendent and an assistant superintendent in works employing several thousand men, located near Chicago, manufacturing heavy machinery. Address, with references and full information, Lock Box No. 1065, Chicago, Ill.

Wanted, at Once—Superintendent and assistant superintendent for large engine manufacturing plant; $5,000 to $12,000 salary; also 95 draftsmen and other competent technical men; over 5,000 positions filled in 10 years. Engineering Agency, Monadnock Block, Chicago.

Wanted—At once, a shop superintendent familiar with steam engine and pumping machinery work; will have complete charge of overhauling large plant; salary $6,000 to $10,000; also assistant superintendent; salary $3,000 to $5,000. Engineering Agency, Monadnock Block, Chicago.

Wanted—Mechanical engineer, designer and draftsman; one familiar with elevating and conveying machinery, belt conveyors, rope transmission and general power transmitting machinery; in writing state age and experience; a good opening for the right man. Stephens-Adamson Mfg. Co., Aurora, Ill.

INDIANA.

Machine shop foreman wanted; must be thoroughly competent; permanent position; good wages. Address Box 273, Indianapolis, Ind.

MASSACHUSETTS.

Wanted—Machinist for lathe and milling work, also young man for office work. Apply at Boston Gear Works, Boston, Mass.

MICHIGAN.

Shop instructors for college work; $1,000 for permanent position; $300 for summer session. Engineering Agency, Monadnock Block, Chicago.

NEW HAMPSHIRE.

Lathe, planer and erecting floor men; give experience and references. Box 123, AM. M.

NEW JERSEY.

Wanted—First-class patternmakers. Apply to the Reeves Engine Co., Trenton, N. J.

Wanted—By the Morris County Machine & Iron Company, Dover, N. J., three good molders; applications must be in writing.

Wanted—First-class machinists, in city near Philadelphia; steady work and good pay. The Reeves Engine Co., Trenton, N. J.

Wanted—Lathe and planer hands for night work on heavy machine tool work; good wages to good men. Apply to The Pond Machine Tool Company, Plainfield, N. J.

NEW YORK.

Wanted—Man to take charge of manufacturing machine tools; young and progressive firm, now employing 40 men. Box 143, A. M.

Wanted—Master mechanic, expert machinist, to work on automatic weighing scales in New York; permanent position. Apply by letter, giving experience and reference, H. Sherin, 6 West 22d St., New York City.

Wanted—A first-class general superintendent; must be capable of handling a large business manufacturing heavy sawmill machinery and heavy engines; age under 40 preferred. Address Clark Bros. Co., Belmont, N. Y.

Young man as assistant foreman of our machine department; experience and executive ability required; exceptional opportunity for the right person. Address or apply Carpenter Enclosed Resistance Co., 130th st. and Park ave., New York City.

Foreman, energetic, executive ability handling milling and screw machine, lathe and planer work, medium class, in modern fireproof factory; state experience, wages expected and references. Address "Up-to-date," care AMERICAN MACHINIST.

Machinists wanted for floor or vise work, by a manufacturing concern now employing 275 men; factory located one hour's ride from New York city; wages $2.50 per day of 9 hours; open shop; no labor troubles past or present; none but sober and industrious men wanted; state age, nationality and experience for past 5 years. Box 151, AM. M.

Wanted—Draftsmen; first-class experienced designers and draftsmen on steam pumps; competent to develop new ideas from rough sketches; must be well grounded in the fundamental principles of steam engineering; answer by mail only, stating salary expected, references, age and experience. A. S. Cameron Steam Pump Works, 433 East 23d st., New York.

OHIO.

Wanted—Good turret lathe hand. Apply Youngstown Mfg. Co., Youngstown, Ohio.

Structural and rolling mill draftsmen. Cleve. Engr. Agency, Sta. B, Cleveland, O.

Wanted—Two or three first-class machinists at once; steady employment; good wages; state whether union or non-union man. Box 314, Youngstown, O.

Machinists—Lathe, floor and vise hands; steady employment and good work in shop of about 300 men, manufacturing machine tools. Address, stating age and give full particulars regarding experience for last 5 years, Box No. 6, Station B, Cleveland, O.

Wanted—An experienced designer, by a concern going into the manufacture of forging machinery and bolt and nut machines for their own use; state where employed, give references, age and pay expected. Address reply to "Bolt & Nut," care AMER. MACH.

PENNSYLVANIA.

Lathe men, bench and vise hands wanted. Apply Searchmont Automobile Co., Trainer, Pa.

First-class machine tool salesman, familiar with all standard metal working tools. Apply to Mr. Albert G. Lea, The J. R. Vandyck Co., The Bourse, Philadelphia, Pa.

Salesman wanted to canvass jobbing trade in Eastern and New England States on plumbing and steamfitting tools; must be young, experienced in this line, of pleasing personality and a hustler. Address Box 471, Erie, Pa.

We are constantly increasing the scope of our work, and invite application for positions from first-class patternmakers, molders and machinists; we always have vacancies. Address The Westinghouse Machine Company, East Pittsburgh, Pa.

VERMONT.

Foreman for general machine shop; specialty, paper making machinery. Address, stating experience, with whom, length of same and lowest wages. Box 111, AMER. MACH.

WEST OF MISSISSIPPI.

Wanted—A machinist who thoroughly understands turret lathes. Box 84, AM. MACH.

Wanted—A first-class accountant who has had experience in figuring costs; state experience, when you could accept a position and salary desired. Address 63 South Robert st., St. Paul, Minn.

General superintendent wanted by machine shop blacksmith and foundry firm; capable of taking entire charge of works, estimating, etc; state age, experience and salary expected. Box 131, AMERICAN MACHINIST.

WISCONSIN.

Wanted—Competent machine and bench hands. The Kempsmith Mfg. Co., Milwaukee, Wis.

Wanted—Draftsman for crane girders and similar work; must be familiar with shop practice and able to get out work quickly and accurately. Pawling & Harnischfeger, Milwaukee, Wis.

An experienced crane salesman to represent us on the road; to a man suited to our needs an excellent opportunity is offered; applications treated confidentially. Pawling & Harnischfeger, Milwaukee, Wis.

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Nanz & Co., H., New York.

Clutches, Friction
Caldwell, Son & Co., H. W., Chicago, Ill.
Faneuil Watch Tool Co., Boston, Mass.
Jacobson Mach. Mfg. Co., Warren, Pa.
New Haven Mfg. Co., New Haven, Conn.
Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.
Smith, F. L., Franklin Falls, N. H.

Compressors, Air
Blanchard Mach. Co., Boston, Mass.
Chicago Pneumatic Tool Co., Chicago, Ill.
Christensen, N. A., Milwaukee, Wis.
Clayton Air Compressor Works, New York.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Gray-Blaisdell Co., Bradford, Pa.
Herron & Bury Mfg. Co., Erie, Pa.
Ingersoll-Sergeant Drill Co., New York.
Jacobson Mach. Mfg. Co., Warren, Pa.
Rand Drill Co., New York.

Consulting Engineer
Thompson, Hugh L., Waterbury, Conn.

Controllers and Starters
Cutler-Hammer Mfg. Co., Milwaukee, Wis.

Coping Machines
Long & Allstatter Co., Hamilton, Ohio.

Correspondence Schools
See Schools, Correspondence.

Counterbores
Slocomb Co., J. T., Provi., R. I.

Countershafts
Builders' Iron Fdry., Provi., R. I.
National Machine Tool Co., Cincinnati, O.
Pratt & Whitney Co., Hartford, Conn.
Reeves Pulley Co., Columbus, Ind.
Wilmarth & Morman Co., Grand Rapids, Mich.

Counting and Printing Wheels
Franklin Mfg. Co., Syracuse, N. Y.

Couplings, Shaft
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Philadel., Pa.
Davis Mach. Co., W. P., Rochester, N. Y.
Patterson, Gottfried & Hunter, Ltd., New York.
Stuart, R. J., New Hamburg, N. Y.

Cranes
Brown Hoisting Mach. Co., N. Y. City.
Case Mfg. Co., Columbus, O.
Chambersburg Engr. Co., Chambersburg, Pa.
Cleveland Crane & Car Co., Cleveland, O.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Franklin Portable Crane & Hoist Co., Franklin, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Philadel., Pa.
Whiting Foundry Equipment Co., Harvey, Ill.

Crank Pin Turning Machine
Underwood & Co., H. B., Philadelphia, Pa.

Crucibles
Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Cupolas, and Ladles, Foundry
Northern Engr. Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Philadel., Pa.
Whiting Foundry Equip. Co., Harvey, Ill.

Cutters, Milling
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Gay & Ward, Athol, Mass.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Whitney Mfg. Co., Hartford, Conn.

Cutting-off Machines
Bement, Miles & Co., New York.
Bignall-Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Davis Mach. Co., W. P., Rochester, N. Y.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.

Cutting-off Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Pratt & Whitney Co., Hartford, Conn.

Diamond Tools
Steel Set Diamond Co., New York.

Dies, Sheet Metal
Bliss Co., E. W., Brooklyn, N. Y.
Hay-Budden Mfg. Co., Brooklyn, N. Y.
Perkins Mach. Co., So. Boston, Mass.
Toledo Mach. & Tool Co., Toledo, Ohio.

Dies, Threading, Opening
Errington, F. A., New York.
Geometric Drill Co., New Haven, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Maines Mach. Co., Philadel., Pa.
Modern Tool Co., Erie, Pa.
Pratt & Whitney Co., Hartford, Conn.

Dowel Pins
Obermayer Co., S., Cincinnati, O.
Winkley Co., Hartford, Conn.

Drawing Boards and Tables
Rich, J. & G., Philadelphia, Pa.

Drawing Instruments
Alteneder & Son, Theo., Philadelphia, Pa.
Keuffel & Esser Co., New York.

Drilling Machines, Bench
Barnes Co., W. F. & John, Rockford, Ill.
Pratt & Whitney Co., Hartford, Conn.

Drilling Machines, Boiler
Aurora Tool Works, Aurora, Ind.
Baush Mch. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Bement, Miles & Co., New York.
Dallett & Co., Thos. H., Phila., Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.

Drilling Machines, Multiple Spindle
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Barr, H. G., Worcester, Mass.
Baush Mch. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Bickford Drill & Tool Co., Cincinnati, O.
Dallett & Co., Thos. H., Phila., Pa.
Fairbanks Co., New York.
Garvin Mach. Co., New York.

Drilling Machines, Multiple Spindle—*Continued*
Harrington, Son & Co., Edwin, Philadelphia, Pa.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Newton Machine Tool Works, Philadelphia, Pa.
Niles Tool Works Co., New York.
Prentiss Tool & Supply Co., New York.
Woodward & Rogers Co., Hartford, Conn.

Drilling Machines, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneu. Tool Co., Cleveland, Ohio.
Phila. Pneumatic Tool Co., Philadelphia, Pa.
Railway Appliances Co., Chicago, Ill.
Rand Drill Co., New York.
Standard Ry. Equip. Co., St. Louis, Mo.

Drilling Machines, Portable
Dallett & Co., Thos. H., Phila., Pa.
Hisey-Wolf Mch. Co., Cincin., O.

Drilling Machines, Radial
American Tool Wks. Co., Cin., O.
Baush Mch. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Bickford Drill & Tool Co., Cincinnati, Ohio.
Cleveland Punch & Shear Works Co., Cleveland, O.
Dreses Mach. Tool Co., Cincin., O.
Fairbanks Co., New York.
Fosdick Mach. Tool Co., Cincin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Mueller Mach. Tool Co., Cincin., O.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Prentiss Tool & Supply Co., New York.

Drilling Machines, Turret
Niles Tool Works Co., New York.
Quint, A. D., Hartford, Conn.
Vanderbeek Tool Works, Hartford, Conn.

Drilling Machines, Upright
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Barr, H. G., Worcester, Mass.
Bement, Miles & Co., New York.
Blaisdell & Co., P., Worcester, Mass.
Brown & Zortman Mchry. Co., Pittsburg, Pa.
Cincinnati Mach. Tool Co., Cin., O.
Davis Mach. Co., W. P., Rochester, N. Y.
Fairbanks Co., New York.
Fosdick Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Murray Mfg. Co., Richmond Valley, S. I., N. Y.
Niles Tool Works Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Sibley & Ware, South Bend, Ind.
Washburn Shops, Worcester, Mass.
Whitney Mfg. Co., Hartford, Conn.
Woodward & Rogers Co., Hartford, Conn.

Drills, Center
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Providence, R. I.

Drills, Rail
Bement, Miles & Co., New York.
Niles Tool Works Co., New York.

Drills, Ratchet
Parker Co., Chas., Meriden, Ct.
Pratt & Whitney Co., Hartford, Conn.

Dynamos
Akron Elec. Mfg. Co., Akron, O.
C & C Electric Co., New York.
Christensen Engineering Co., Milwaukee, Wis.
Commercial Electric Co., Indianapolis, Ind.
Crocker-Wheeler Electric Co., Ampere, N. J.
Eck Dynamo & Motor Co., Belleville, N. J.
General Elec. Co., New York.
Jantz & Leist Elec. Co., Cincin., O.
Mechanical Appliance Co., Milwaukee, Wis.
Milwaukee Elec. Co., Milwaukee, Wis.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Roth Bros. & Co., Chicago, Ill.
Sprague Elec. Co., New York.
Storey Motor & Electric Co., Harrison, N. J.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.

Electrical Supplies
Akron Elec. Mfg. Co., Akron, O.
Commercial Electric Co., Indianapolis, Ind.
General Elec. Co., New York.
Milwaukee Elec. Co., Milwaukee, Wis.
Storey Motor & Electric Co., Harrison, N. J.
Triumph Electric Co., Cincin., O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Elevators
Albro-Clem Elevator Co., Philadelphia, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Howard Iron Wks., Buffalo, N. Y.
Morse, Williams & Co., Phila., Pa.

Emery Wheels
See Grinding Wheels.

Enclosures, Tool-room
Merritt & Co., Philadelphia, Pa.

Engines, Automobile
Olds Motor Works, Lansing, Mich.

Engines, Gas and Gasoline
Backus Water Motor Co., Newark, N. J.
Elyria Engine Co., Elyria, O.
Foos Gas Eng. Co., Springfield, O.
Middletown Mach. Co., Middletown, O.
Mietz, August, New York.
National Engine Co., Rockford, Ill.
New Era Iron Wks., Dayton, O.
Olds Motor Wks., Lansing, Mich.
Stover Engine Works, Freeport, Ill.
Struthers-Wells Co., Warren, Pa.

Engines, Steam
Buffalo Forge Co., Buffalo, N. Y.
Frick Co., Waynesboro, Pa.
Rand Drill Co., New York.
Struthers-Wells Co., Warren, Pa.

Exhaust Fans
Buffalo Forge Co., Buffalo, N. Y.

Exhaust Heads
Burt Mfg. Co., Akron, O.

Eye Shield
The Texas Co., Chicago, Ill.

Fans, Electric
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Feed Water Heater and Purifier
Hawley Down Draft Furnace Co., Chicago, Ill.

Files and Rasps
Barnett Co., G. & H., Phila., Pa.
Hammacher, Schlemmer & Co., New York.
Nicholson File Co., Provi., R. I.
Patterson, Gottfried & Hunter, Ltd., New York.
Troy File Works, Troy, N. Y.

Filing Machines
Cochrane-Bly Mach. Co., Rochester, N. Y.

Fillers, Oil Can
The Winkley Co., Hartford, Conn.

Filters, Oil
Burt Mfg. Co., Akron, O.

Fittings, Steam
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Jenkins Bros., New York.
Lunkenheimer Co., Cincinnati, O.
Walworth Mfg. Co., Boston, Mass.

Flexible Shafts
Chicago Flexible Shaft Co., Chicago, Ill.

Forges
Buffalo Forge Co., Buffalo, N. Y.
Patterson, Gottfried & Hunter, Ltd., New York.

Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
Hay-Budden Mfg. Co., Brooklyn, N. Y.
Pittsburg Shear Knife & Mach. Co., Pittsburg, Pa.
Wyman & Gordon, Worcester, Mass.

Foundry Furnishings
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Philadel., Pa.
Whiting Foundry Equip. Co., Harvey, Ill.

Furnaces, Coal and Oil
Buffalo Forge Co., Buffalo, N. Y.
Hawley Down Draft Furnace Co., Chicago, Ill.
Jacobson Mach. Mfg. Co., Warren, Pa.
Obermayer Co., S., Cincinnati, O.

Furnaces, Gas
Am. Gas Furnace Co., N. Y. City.
Chicago Flexible Shaft Co., Chicago, Ill.

Furniture, Machine Shop
New Britain Mach. Co., New Britain, Conn.

Gages, Recording
Bristol Co., Waterbury, Conn

Gages, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gages, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Gear Cutting Machinery
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Newton Mch. Tool Wks., Phil., Pa.
Niles Tool Works Co., New York.
Whiton Machine Co., D. E., New London, Conn.

Gears, Cut
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Works, Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Fawcus Mach. Co., Pittsburgh, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.

Gears, Cut—*Continued*
Horsburgh & Scott, Cleveland, O.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Philadelphia Gear Works, Philadelphia, Pa.
Sawyer Gear Wks., Cleveland, O.
Simonds Mfg. Co., Pittsburgh, Pa.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cincin., O.

Gears, Rawhide
Chicago Raw Hide Co., Chicago, Ill.
Fawcus Mch. Co., Pittsburgh, Pa.
Horsburgh & Scott, Cleveland, O.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Fawcus Mach. Co., Pittsburgh, Pa.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburgh, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. J.
Lubriphite Co., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Center
Heald & Son, L. S., Barre, Mass.
Hisey-Wolf Mach. Co., Cincin., O.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter
Adams Co., Dubuque, Iowa.
Automatic Mach. Co., Greenfield, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Machine Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.
Woodward & Rogers Co., Hartford, Conn.

Grinders, Disc
Besly & Co., Chas. H., Chicago, Ill.
Gorton Mach. Co., Geo., Racine, Wis.
Iroquois Mach. Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.

Grinders, Drill
Gorton Mach. Co., Geo., Racine, Wis.
Heald & Son, L. S., Barre, Mass.
Standard Tool Co., Cleveland, O.
Washburn Shops, Worcester, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Tool
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Barr, H. G., Worcester, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Diamond Mach. Co., Provi., R. I.
Gisholt Mach. Co., Madison, Wis.
Landis Tool Co., Waynesboro, Pa.
Modern Tool Co., Erie, Pa.
Northampton Emery Wheel Co., Leeds, Mass.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, O.
Throop Perforating Co., Buffalo, N. Y.
Whitney Mfg. Co., Hartford, Ct.

Grinding Machines
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Fairbanks Co., New York.
Falkenau-Sinclair Co., Phila., Pa.
Goodell-Pratt Co., Greenfield, Mass.
Gorton Mach. Co., Geo., Racine, Wis.

Grinding Machines—*Cont'd*
Greenfield Mach. Co., Greenfield Mass.
Hill, Clarke & Co., Boston, Mass.
Hisey-Wolf Mch. Co., Cincin., O.
Iroquois Mach. Co., New York.
Landis Tool Co., Waynesboro, Pa.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Mechanical Appliance Co., Milwaukee, Wis.
Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.
Norton Grinding Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, Ohio.
Throop Perforating Co., Buffalo, N. Y.
Washburn Shops, Worcester, Mass.
Webster & Perks Tool Co., Springfield, O.
Wilmarth & Morman Co., Grand Rapids, Mich.
Woodward & Rogers Co., Hartford, Conn.

Grinding Wheels
Builders' Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Diamond Mach. Co., Provi., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Whitney Mfg. Co., Hartford, Conn.

Gun Barrel Machinery
Bement, Miles & Co., New York.
Diamond Mach. Co., Provi., R. I.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Reed Co., F. E., Worcester, Mass.

Hack Saw Blades and Frames
Diamond Saw & Stamping Wks., Buffalo, N. Y.
Goodell-Pratt Co., Greenfield, Mass.
Hammacher, Schlemmer & Co., New York.
Millers Falls Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Starrett Co., L. S., Athol, Mass.
West Haven Mfg. Co., New Haven, Conn.

Hack Saws, Power
Diamond Saw & Stamping Wks., Buffalo, N. Y.
Hoefer Mfg. Co., Freeport, Ill.
Millers Falls Co., New York.
West Haven Mfg. Co., New Haven, Conn.

Hammers, Drop
Bement, Miles & Co., New York.
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Mossberg & Granville Mfg. Co., Providence, R. I.
Perkins Mach. Co., Boston, Mass.
Toledo Mach. & Tool Co., Toledo, Ohio.

Hammers, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Dallett & Co., Thos. H., Phila., Pa.
Phila. Pneu. Tool Co., Philadelphia, Pa.
Railway Appliances Co., Chicago, Ill.
Rand Drill Co., New York.
Standard Ry. Equip. Co., St. Louis, Mo.

Hammers, Power
Scranton & Co., The, New Haven, Conn.

Hammers, Steam
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Chambersburg Engr. Co., Chambersburg, Pa.
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Pittsburg Shear Knife & Mach. Co., Pittsburg, Pa.

Heating and Ventilating Apparatus
Buffalo Forge Co., Buffalo, N. Y.

Heating Machines, Automatic
Am. Gas Furnace Co., New York.

Hoisting and Conveying Machinery
Brown Hoisting Mchry. Co., New York.
Caldwell & Son Co., H. W., Chicago, Ill.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

Hoists, Electric
C & C Electric Co., New York.
Hunt Co., C. W., West New Brighton, N. Y.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger, Milwaukee, Wis.
Sprague Electric Co., New York.

Hoists, Hand
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Northern Engineering Wks., Detroit, Mich.
Rand Drill Co., New York.

Hose Coupler
Clark Co., W. J., Salem, O.

Igniters, Gas Engine
Dayton Electrical Mfg. Co., Dayton, O.

Indicators, Speed
Starrett Co., L. S., Athol, Mass.

Indicators, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Injectors
Lunkenheimer Co., Cincinnati, O.
Sellers & Co., Wm., Phila., Pa.

Inspection and Tests
Hunt Co., Robt. W., Chicago, Ill.

Instruction Schools
See Schools, Correspondence.

Insurance, Boiler
Hartford Steam Boiler Insp. & Ins. Co., Hartford, Conn.

Jacks, Hydraulic
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Jack Planer
Armstrong Bros. Tool Co., Chicago, Ill.

Key Seaters
Baker Bros., Toledo, O.
Bement, Miles & Co., New York.
Chattanooga Mchry. Co., Chattanooga, Tenn.
Davis Mach. Co., W. P., Rochester, N. Y.
Mutts & Merrill, Saginaw, Mich.
Whitney Mfg. Co., Hartford, Conn.

Keys, Machine
Standard Gauge Steel Co., Beaver Falls, Pa.
Whitney Mfg. Co., Hartford, Ct.

Knives, Solid Steel Shear
Pittsburg Shear Knife & Mach. Co., Pittsburg, Pa.

Lamps, Arc
General Electric Co., N. Y. City.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Lathe Attachments
National Machine Tool Co., Cincinnati, O.

Lathe Dogs
Armstrong Bros. Tool Co., Chicago, Ill.
Besly & Co., Chas. H., Chicago, Ill.
Le Count, Wm. G., So. Norwalk, Conn.
Pratt & Whitney Co., Hartford, Conn.
Tindel-Morris Co., Eddystone, Pa.

Lathes
Affleck, Geo. E., New York.
American Tool Wks. Co., Cin., O.
Automatic Mach. Co., Greenfield, Mass.
Barker & Co., Wm., Cincinnati, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bement, Miles & Co., New York.
Blaisdell & Co., P., Worcester, Mass.
Bradford Mach. Tool Co., Cin., O.
Brown & Zortman Mchry. Co., Pittsburg, Pa.
Bullard Mach. Tool Co., Bridgeport, Conn.
Davis Mach. Co., W. P., Rochester, N. Y.
Diamond Machine Co., Prov., R. I.
Draper Mach. Tool Co., Worcester, Mass.
Fairbanks Co., New York.
Fay & Scott, Dexter, Me.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Greaves, Klusman Co., Cincin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mch. Tool Co., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Milwaukee Machine Tool Co., Milwaukee, Wis.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Reed Co., F. E., Worcester, Mass.
Schumacher & Boye, Cincinnati, Ohio.
Sebastian Lathe Co., Cincin., O.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Washburn Shops, Worcester, Mass.

Lathes, Automatic Screw-Threading
Automatic Machine Co., Bridgeport, Conn.

Lathes, Bench
Faneuil Watch Tool Co., Boston, Mass.
Loop-Lock Mach. Co., Waltham, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Lathes, Boring
Streit Mach. Co., A., Cincin., O.

Letters, Pattern
Brim, A. W., Seneca Falls, N. Y.
Butler, A. G., N. Y. City.

Levels
Mass. Tool Co., Greenfield, Mass.
Starrett Co., L. S., Athol, Mass.

Lockers, Clothes
Merritt & Co., Philadelphia, Pa.
Narragansett Mach. Co., Providence, R. I.

Locomotives, Shop
Hunt Co., C. W., West New Brighton, N. Y.

Lubricants
Besly & Co., Chas. H., Chicago, Ill.
Dixon Crucible Co., Jos., Jersey City, N. J.
Lubriphite Co., Jersey City, N. J.

Lubricators
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lubriphite Co., Jersey City, N. J.
Lunkenheimer Co., Cincinnati, O.

Machine Screws
Atlantic Mach. Screw Co., Boston, Mass.
Worcester Mach. Screw Co., Worcester, Mass.

Machinery Builders, Special
American Fdry. & Mach. Co., Hanover, Pa.
Blanchard Mach. Co., The, Boston, Mass.
Eclipse Mach. Co., Cleveland, O.
Fawcus Mch. Co., Pittsburgh, Pa.
Hoefer Mfg. Co., Freeport, Ill.
Pratt & Whitney Co., Hartford, Conn.
Simonds Mfg. Co., Pittsburgh, Pa.
Woodward & Rogers Co., Hartford, Conn.

Machinists' Small Tools
Besly & Co., Chas. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
McCrosky & Huber, Cincinnati, O.
Mass. Tool Co., Greenfield, Mass.
Patterson, Gottfried & Hunter, Ltd., New York.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Provi., R. I.
Standard Tool Co., Cleveland, O.
Starrett Co., L. S., Athol, Mass.

Machinists' Supplies
Hammacher, Schlemmer & Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.

Mandrels, Expanding
Nicholson & Son, W. H., Wilkesbarre, Pa.

Mandrels, Solid
Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Measuring Machines
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.

Metal, Bearing
Besly & Co., Chas. H., Chicago, Ill.
Patterson, Gottfried & Hunter, Ltd., New York.

Metal, Perforated
Throop Perforating Co., Buffalo, N. Y.

Micrometer Calipers
Brown & Sharpe Mfg. Co., Providence, R. I.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

Milling Attachments
The Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Kempsmith Mfg. Co., Milwaukee, Wis.
Whitney Mfg. Co., Hartford, Conn.

Milling Machines, Bench
Faneuil Watch Tool Co., Boston, Mass.
Hill, Clarke & Co., Boston, Mass.
Loop-Lock Mach. Co., Waltham, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Horizontal
Adams Co., Dubuque, Iowa.
Beaman & Smith Co., Prov., R. I.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bement, Miles & Co., New York.
Hendey Mach. Co., Torrington, Ct.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Milling Machines, Portable
Underwood & Co., H. B., Philadelphia, Pa.

Milling Machines, Plain

American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Fairbanks Co., New York.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Marshall & Huschart Mchry. Co., Chicago, Ill.
McCabe, J. J., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Universal

American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Fairbanks Co., New York.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Marshall & Huschart Mchry. Co., Chicago, Ill.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Vertical

Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Garvin Mach. Co., New York.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mch. Tool Works, Philadelphia, Pa.
Niles Tool Works Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Pratt & Whitney Co., Hartford, Conn.
Quint, A. D., Hartford, Conn.

Milling Tools, Adjustable

Geometric Drill Co., New Haven, Conn.
Rogers, Boat, Gage & Drill Wks., John M., Gloucester City, N. J.

Molding Machines

Adams Co., The, Dubuque, Iowa.
American Foundry & Mach. Co., Hanover, Pa.
Tabor Mfg. Co., Philadelphia, Pa.
Webster & Perks Tool Co., Springfield, O.

Motors, Electric

Akron Elec. Mfg. Co., Akron, O.
C & C Electric Co., New York.
Christensen Engr. Co., Milwaukee, Wis.
Commercial Electric Co., Indianapolis, Ind.
Crocker-Wheeler Co., Ampere, N.J.
Cutler-Hammer Mfg. Co., Milwaukee, Wis.
Eck Dynamo & Motor Wks., Belleville, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Mechanical Appliance Co., Milwaukee, Wis.
Milwaukee Elec. Co., Milwaukee, Wis.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Roth Bros. & Co., Chicago, Ill.
Sprague Electric Co., New York.
Storey Motor & Electric Co., Harrison, N. J.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Name Plates

Franklin Mfg. Co., Syracuse, N. Y.

Nut Tappers

See Bolt and Nut Machinery.

Oil Cups and Covers

Bay State Stamping Works, Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.
Tucker, W. W. & C. F., Hartford, Conn.
The Winkley Co., Hartford, Conn.

Oils

Besly & Co., Chas. H., Chicago, Ill.
Harris Oil Co., A. W., Provi., R. I.

Oils, Slushing

Harris Oil Co., A. W., Provi., R. I.

Oil Stones

Pike Mfg. Co., Pike Station, N. H.

Packing, Steam Joint

Jenkins Bros., New York.
N. Y. Belting & Packing Co., New York.
Peerless Rubber Mfg. Co., New York.

Pans, Lathe

New Britain Mch. Co., New Britain, Conn.

Patents

Baldwin, Davidson & Wight, Washington, D. C.
Straley, Hasbrouck & Schloeder, New York.

Pattern Shop Machinery

Baker Bros., Toledo, O.
Brown & Zortman Mchry. Co., Pittsburg, Pa.
Fairbanks Co., New York.
Fay & Scott, Dexter, Me.
Greaves, Klusman & Co., Cin., O.
Prentiss Tool & Supply Co., New York.
Washburn Shops, Worcester, Mass.

Pencils

Dixon Crucible Co., Jos., Jersey City, N. J.
Keuffel & Esser Co., New York.

Phosphor Bronze

Phosphor Bronze Smelting Co., Philadelphia, Pa.

Pinion Cutters

Loop-Lock Mach. Co., Waltham, Mass.

Pipe and Fittings

Crane Co., Chicago, Ill.

Pipe Cutting and Threading Machines

Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Curtis & Curtis Co., Bridgeport, Conn.
Merrell Mfg. Co., Toledo, O.
Reed Mfg. Co., Erie, Pa.
Saunders' Sons, D., Yonkers, N. Y.
Wells Bros. Co., Greenfield, Mass.

Pipe Fitters' Tools

Cleveland Twist Drill Co., Cleveland, O.
Saunders' Sons, D., Yonkers, N. Y.
Standard Tool Co., Cleveland, O.

Planers

Affleck, Geo. E., New York.
American Tool Wks. Co., Cin., O.
Belmer Mach. Tool Co., Cin., O.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del
Cincinnati Planer Co., Cincin., O.
Detrick & Harvey Mch. Co., Baltimore, Md.
Fairbanks Co., New York.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Gray Co., G. A., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Pond Mach. Tool Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Wm., Phila., Pa.

Planers—*Continued*

Whitcomb Mfg. Co., Worcester, Mass.
Woodward & Powell Planer Co., Worcester, Mass.

Planers, Bench

Bartlett, E. E., Boston, Mass.

Planers, Portable

Underwood & Co., H. B., Philadelphia, Pa.

Planers, Rotary

Bement, Miles & Co., New York.
Cleveland Punch & Shear Works, Cleveland, O.
Newton Mach. Tool Wks., Philadelphia, Pa.
Pond Mach. Tool Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Presses, Hand

Elmes Engr. Works, Chas. F., Chicago, Ill.
Perkins Mach. Co., So. Boston, Mass.

Presses, Hydraulic

Elmes Engr. Works, Chas. F., Chicago, Ill.
Watson-Stillman Co., New York.

Presses, Power

Automatic Mach. Co., Bridgeport, Conn.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Chambersburg Engr. Co., Chambersburg, Pa.
Fairbanks Co., New York.
Mossberg & Granville Mfg. Co., Providence, R. I.
Perkins Mach. Co., So. Boston, Mass.
Prentiss Tool & Supply Co., New York.
Toledo Mach. & Tool Co., Toledo, Ohio.

Profilers

Garvin Mach. Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Pulleys

Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Federal Mfg. Co., Cleveland, O.
Howard Iron Wks., Buffalo, N. Y.
Oneida Steel Pulley Co., Oneida, N. Y.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.
The Xylotite Co., Cincinnati, O.

Pulleys, Friction Cone

Evans Friction Cone Co., Boston, Mass.

Pulleys, Speed Changing

Speed Changing Pulley Co., Indianapolis, Ind.

Pulley Turning and Boring Machines

Harrington, Son & Co., Edwin, Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Streit Mach. Co., A., Cincin., O.

Pumps, Hydraulic

Elmes Engr. Works, Chas. F., Chicago, Ill.
Watson-Stillman Co., New York.

Punches, Hydraulic

Bement, Miles & Co., New York.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Punches, Power

Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cincinnati Punch & Shear Co., Cincinnati, O.
Cleveland Punch & Shear Wks., Co., Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Perkins Mach. Co., S. Boston, Mass.

Rack Cutting Machines

Fellows Gear Shaper Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Reed Co., F. E., Worcester, Mass.

Racks, Cut

Fellows Gear Shaper Co., Springfield, Vt.
Nuttall Co., R. D., Pittsburgh, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.
Standard Gauge Steel Co., Beaver Falls, Pa.

Racks, Tool

New Britain Mach. Co., New Britain, Conn.

Reamers

Cleveland Twist Drill Co., Cleveland, O.
Clough, R. M., Tolland, Conn.
McCrosky & Huber, Cincinnati, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
New Process Twist Drill Co., Taunton, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.

Reaming Stands

Flather Planer Co., Mark, Nashua, N. H.

Rheostats

Cutler-Hammer Mfg. Co., Milwaukee, Wis.

Riveters, Hydraulic

Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Riveters, Pneumatic

Bement, Miles & Co., New York.
Cleveland Pneumatic Tool Co., Cleveland, O.
Philadelphia Pneumatic Tool Co., Philadelphia, Pa.
Railway Appliances Co., Chicago, Ill.
Rand Drill Co., New York.
Standard Ry. Equip. Co., St. Louis, Mo.

Riveting Machines

Bement, Miles & Co., New York.
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Chambersburg Engr. Co., Chambersburg, Pa.
Long & Allstatter Co., Hamilton, Ohio.
Perkins Mach. Co., So. Boston, Mass.

Roller and Ball Bearings

Ball Bearing Co., Philadel., Pa.
Bantam Mfg. Co., Bantam, Conn.
Mossberg & Granville Mfg. Co., Providence, R. I.

Rolling Mill Machinery

Cleveland Punch & Shear Wks., Co., Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Mossberg & Granville Mfg. Co., Providence, R. I.
Pratt & Whitney Co., Hartford, Conn.

Rubber Goods, Mechanical

N. Y. Belting & Packing Co., New York.
Peerless Rubber Mfg. Co., New York.

Rules, Steel

Mass. Tool Co., Greenfield, Mass.
Sawyer Tool Co., Fitchburg, Mass.
Slocomb Co., J. T., Provi., R. I.
Starrett Co., L. S., Athol, Mass.

Safety Valves, Pop

Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.

Sand Blast Apparatus

Paxson Co., J. W., Philadel., Pa.

Sand Mixing Machines

Obermayer Co., S., Cincinnati, O.

Sawing Machines, Metal

Cleveland Punch & Shear Works Co., Cleveland, O.
Cochrane-Bly Mach. Works, Rochester, N. Y.
Newton Mach. Tool Works, Philadelphia, Pa.
Pratt & Whitney Co., Hartford, Conn.
West Haven Mfg. Co., New Haven, Conn.

Sawing Machines, Wood
Brown & Zortman Mchry. Co., Pittsburg, Pa.

Schools, Correspondence
Amer. School of Correspondence, Chicago, Ill.
Consolidated Schools, N. Y. City.
International Correspond. Schools, Scranton, Pa.

Schools, Technical
State College of Ky., Lexington, Ky.

Screw Machines, Automatic
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Dreses Mach. Tool Co., Cincin., O.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Windsor Mach. Co., Windsor, Vt.

Screw Machines, Hand
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Draper Mach. Tool Co., Worcester, Mass.
Garvin Mach. Co., New York.
Jones & Lamson Mch. Co., Springfield, Vt.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Screw Machinery, Wood and Lag
Baker Bros., Toledo, Ohio.
Cook Co., Asa S., Hartford, Conn.

Screw Plates
Besly & Co., Chas. H., Chicago, Ill.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Card Mfg. Co., S. W., Mansfield, Mass.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Second Hand Machinery
Allleck, Geo. E., New York.
Baird Machy. Co., Pittsburg, Pa.
Bennett, G. L., New York.
Bowler & Co., Geo. H., Cleveland, Ohio.
Brown & Zortman Mchry. Co., Pittsburg, Pa.
Carlin Mchry. & Supply Co., Allegheny, Pa.
Fairbanks Co., New York.
Fairbanks Co., Philadelphia, Pa.
Garvin Mch. Co., New York.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mchry. Co., Chicago, Ill.
McCabe, J. J., New York.
Niles-Bement-Pond Co., New York.
Packard Machinery Co., O. L., Chicago, Ill.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Toomey, Frank, Philadelphia, Pa.
Wickes Bros., New York.
Wormer Machy. Co., C. C., Detroit, Mich.

Separators, Magnetic
Sawyer, Ezra, Worcester, Mass.

Shapers
American Tool Wks. Co., Cin., O.
Parker & Co., Wm., Cincinnati, O.
Bement, Miles & Co., New York.
Cincinnati Shaper Co., Cincin., O.
Fairbanks Co., New York.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Gould & Eberhardt, Newark, N. J.
Hendey Mch. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kelly Co., R. A., Xenia, Ohio.
Marshall & Huschart Mchry. Co., Chicago, Ill.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Perkins Mach. Co., So. Boston, Mass.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Prentiss Tool & Supply Co., New York.

Shapers—*Continued*
Smith & Mills, Cincinnati, O.
Steptoe Shaper Co., John, Cincinnati, O.

Shears, Power
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cincinnati Punch & Shear Co., Cincinnati, O.
Cleveland Punch & Shear Works, Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Perkins Mach. Co., So. Boston, Mass.
Toledo Mach. & Tool Co., Toledo, Ohio.

Shears, Rotary
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.
Perkins Mach. Co., So. Boston, Mass.

Shelving, Shop
New Britain Mach. Co., New Britain, Conn.

Slide Rests
Bartlett, E. E., Boston, Mass.
Reed Co., F. E., Worcester, Mass.
Rhodes, L. E., Hartford, Conn.

Slotters
Baker Bros., Toledo, Ohio.
Barr, H. G., Worcester, Mass.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Garvin Mach. Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.

Sockets and Sleeves
New Process Twist Drill Co., Taunton, Mass.

Sprocket Chains
See Driving Chains.

Stampings, Sheet Steel
Federal Mfg. Co., Cleveland, O.

Stamps, Steel
Schwerdtle Stamp Co., Bridgeport, Conn.

Steel, Machinery
Boker & Co., Hermann, New York.
Patriarche & Bell, New York.
Ward & Son, Edgar T., Boston, Mass.

Steel, Sheet
Federal Mfg. Co., Cleveland, O.
Ward & Son, Edgar T., Boston, Mass.

Steel, Tool
Boker & Co., Hermann, New York.
Firth-Sterling Steel Co., Demmler, Pa.
Patriarche & Bell, New York.
Patterson, Gottfried & Hunter, Ltd., New York.

Stones, Oil
Pike Mfg. Co., Pike Station, N. H.

Straightener, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Swaging Machines
Excelsior Needle Co., Torrington, Conn.
Mossberg & Granville Mfg. Co., Providence, R. I.

Switchboards
C & C Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Tapping Machines and Attachments
Baker Bros., Toledo, O.
The Beaman & Smith Co., Providence, R. I.
Bickford Drill & Tool Co., Cin., O.
Cincinnati Mach. Tool Co., Cincinnati, O.
Errington, F. A., N. Y. City.
Fosdick Mach. Tool Co., Cin., O.

Tapping Machines and Attachments—*Continued*
Garvin Mach. Co., New York.
Geometric Drill Co., New Haven, Conn.
Modern Tool Co., Erie, Pa.
Murray Mfg. Co., Richmond Valley, S. I., N. Y.
Pratt & Whitney Co., Hartford, Conn.
Quint, A. D., Hartford, Conn.
Webster & Perks Tool Co., Springfield, O.
Whitney Mfg. Co., Hartford, Conn.
Woodward & Rogers Co., Hartford, Conn.

Taps, Collapsing
Geometric Drill Co., New Haven, Conn.

Taps and Dies
Besly & Co., Chas. H., Chicago, Ill.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Crane Co., Chicago, Ill.
Geometric Drill Co., New Haven, Conn.
Hammacher, Schlemmer & Co., New York.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Patterson Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.
Webster & Perks Tool Co., Springfield, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Telephone System
Clark Auto. Telephone Switch Board Co., Providence, R. I.

Thread Cutting Tools
Besly & Co., Chas. H., Chicago, Ill.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Tool Holders
Armstrong Bros. Tool Co., Chicago, Ill.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
McCrosky & Huber, Cincinnati, O.

Tools, Small
See Machinists' Small Tools.

Tracing Cloth
Hardtmuth, L. & C., New York.

Transmission Machinery
Caldwell & Son Co., H. W., Chicago, Ill.
Case Mfg. Co., Columbus, O.
Cresson & Co., Geo. V., Phila., Pa.
Federal Mfg. Co., Cleveland, O.
Link-Belt Engineering Co., Philadelphia, Pa.
National Machine Tool Co., Cincinnati, O.
Oneida Steel Pulley Co., Oneida, N. Y.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.

Trimmers, Wood
Washburn Shops, Worcester, Mass.

Trolleys and Tramways
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Yale & Towne Mfg. Co., New York.

Tubing, Steel
Shelby Steel Tube Co., Pittsburgh, Pa.

Turret Machines
Amer. Tool & Machine Co., Boston, Mass.
Automatic Mach. Co., Greenfield, Mass.
Bradford Mach. Tool Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Mach. Tool Co., Bridgeport, Conn.
Dreses Mach. Tool Co., Cincin., O.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.

Turret Machines—*Continued*
Gisholt Mch. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Jones & Lamson Mch. Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
Milwaukee Mach. Tool Co., Milwaukee, Wis.
Niles Tool Works Co., New York.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnson Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Turrets, Carriage
Fay & Scott, Dexter, Me.

Twist Drills
Cleveland Twist Drill Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
Morse Twist Drill & M. Co., New Bedford, Mass.
New Process Twist Drill Co., Taunton, Mass.
Patterson, Gottfried & Hunter, Ltd., New York.
Standard Tool Co., Cleveland, O.

Unions, Brass
Nolte Brass Co., Springfield, O.

Universal Joints
Baush Machine Tool Co., Springfield, Mass.
Vanderbeek Tool Wks., Hartford, Conn.

Valves
See Steam Fittings.

Vises, Drill
Graham Mfg. Co., Provi., R. I.
Hollands Mfg. Co., Erie, Pa.
Jacobson Mach. Mfg. Co., Warren, Pa.

Vises, Metal Workers'
Hammacher, Schlemmer & Co., New York.
Hanna, E. E., Chicago, Ill.
Howard Iron Wks., Buffalo, N. Y.
Jacobson Mach. Mfg. Co., Warren, Pa.
Parker Co., Chas., Meriden, Conn.
Prentiss Vise Co., New York.
Reed Mfg. Co., Erie, Pa.
Walworth Mfg. Co., Boston, Mass.

Vises, Pipe
Curtis & Curtis Co., Bridgeport, Conn.
Prentiss Vise Co., New York.
Saunders' Sons, D., Yonkers, N. Y.
Walworth Mfg. Co., Boston, Mass.

Vises, Planer and Shaper
Cincinnati Planer Co., Cincin., O.
Hendey Mach. Co., Torrington, Ct.
Pratt & Whitney Co., Hartford, Conn.

Vises, Wood Workers'
Hammacher, Schlemmer & Co., New York.
Wyman & Gordon, Worcester, Mass.

Welding Machines
Long & Allstatter Co., Hamilton, Ohio.

Wire-Drawing Machinery
Iroquois Mach. Co., New York.
Mossberg & Granville Mfg. Co., Providence, R. I.

Wire-Forming Machinery
Automatic Mach. Co., Bridgeport, Conn.

Wire-Straightening Machinery
Hoefer Mfg. Co., Freeport, Ill.

Worm Hobbing Machines
Pratt & Whitney Co., Hartford, Conn.

Worm Milling Machines
Cleveland Automatic Mach. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.

Wrenches
Coes Wrench Co., Worcester, Mass.

Wrenches, Drop Forged
Billings & Spencer Co., Hartford, Conn.

Designing Tools—A Milling Job and Fixture.

BY P. D. BERT.

Given a machine to manufacture, the tool engineer will attack the task with more or less skill, according to his make-up and experience. It is a fact that no amount of experience can overcome an engineer's peculiarities; he may vary in excellence, but he can never surmount his distinguishing fault. Hazard's fault will be in taking too great risks and in the introduction of too many new, untried elements; while Fabian will stick to principles which others have found to work successfully under like circumstances. Fabian's tools will generally work, but anybody could have designed them; they do not accomplish much. Hazard, on the contrary, may create a masterpiece, but the chances are that many of his untried motions will be crudely developed and give unsatisfactory performances. Between Fabian and Hazard comes Wright, the man who is able to turn himself down and tune himself up. Behind Wright are years of experience and the memory of what has been eminently successful, and in his brain lies a record of the many failures he has observed, together with some shrewd theories of why they were failures. Together with these he has noticed that, in a failure, all the elements did not fail; from such failures he is able to select the good and reject the bad. Added to all this, Wright has a judicious and trained originality; the ability to take the next step forward and the faculty to build a safe bridge over untried waters; the talent to find the thing needed where nothing already exists that exactly fills the requirements. The Wright family is small.

So much for the engineers; let us get to designing tools. The first thing to know is how many of the thing to be manufactured are wanted within a given time? Upon that answer depends the character of your tools. If there is a steady demand for five thousand each week, you can luxuriate in tools of an automatic nature; but if there are but one hundred needed every month, then the problem is worthy the attention of an expert; it is infinitely easier to design tools for the larger quantity mentioned than for the smaller. You can always duplicate a small tool, but it is impossible to halve it; there are few that can be transformed to do more than one thing well—in fact, this is not often tried. Now one hundred a month, or less, is the rule for the average size of American manufactured products which are so like that they can be made from the same tools. Watches, sewing machines, pistols and other arms, and typewriters, are among the things that exceed this output; while engines, planers, lathes, printing presses and type-casting machines fall below it.

There is no machine as familiar to the readers of this paper as the ordinary engine lathe, consisting of a bed, a headstock, a tailstock, a carriage and means to operate it. Let us consider the bed of a lathe and the means to make it. While some eminent toolmakers have tried to mill lathe beds, with indifferent success, it may safely be said that they are planed as a rule. Why? Because of two things: First, the iron of which a bed should be made is hard and destroys the cutters too rapidly either for efficiency or for economy; second, the beds are not sufficiently rigid to withstand the pressure; they spring out of truth. There is an immense difference between the pressure from the action of a single pointed tool and that from a gang of milling cutters, and when it costs more to scrape a milled surface, compared with a planed one, than is saved by milling it, there will be no time lost in discontinuing the experiment. Still the experiment has never been exhaustively tried. There is no doubt that, if a suitably constructed milling machine, one arranged to complete the whole bed-top in one operation, or rather at one setting, and made as rigid as possible, were tried on a bed strengthened for rigidity to a sufficient extent, and with cutters made of one of the modern wear-resisting steels, the milling of the piece could be done with economy.

Here is the place to say that a tool engineer should be capable of reconstructing the part to be machined, if necessary to the economies of manufacture. This can usually be done, when the circumstances demand it, without changing a single function of the part, or of affecting another part; often an improvement may be effected. If an engineer is not capable of this, he lacks considerably of the necessary qualifications for the best service in tool designing. And no manufacturer should hesitate to second an efficient man in this particular; on the contrary, he should demand it in preference to an inferior result.

Milling cutters for such purposes as are indicated above should be kept mounted, each gang on its own arbor, and not disturbed except for sharpening. This principle is especially important in circumstances where the cut on one piece is to match another to which it is to be fitted, or if it is to conform to a gage. The final cut on the shears of a XX lathe bed should be done with a gang of cutters operating on all at once, and should cut only the angles of sides and be the last thing done, excepting the under gib ways, perhaps. Neither of these final cuts should exceed three-thousandths of an inch. These final cuts should be done after the bed has been released from the rigid clamping necessary for the heavy cuts. To facilitate this and to prevent lateral shift, it will be well to

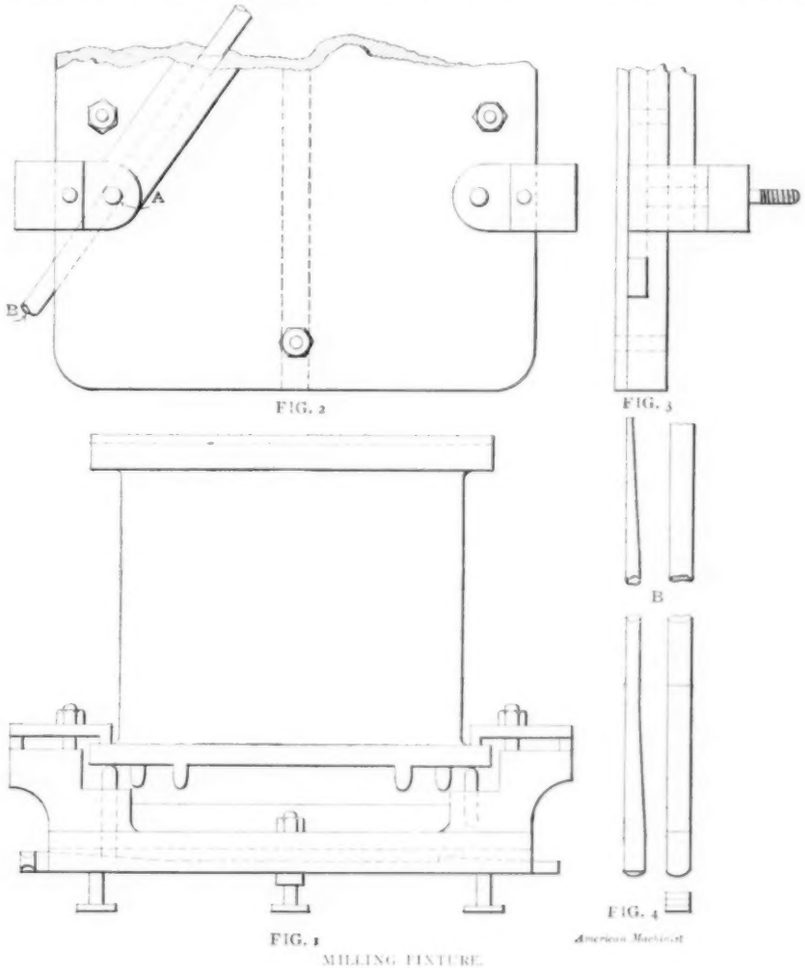

FIG. 2 FIG. 3 FIG. 4

FIG. 1 American Machinist

MILLING FIXTURE.

mill the beds in a bolster made on purpose for it in which it may be held with very little clamping.

As often happens, we have drifted into details too soon. Still it is not an unmixed evil; a digression sometimes, like a tale on a journey, breaks the monotony of the "'Ammer, 'ammer, 'ammer hof the 'ard 'ighway" toward experience. The tool engineer, being given a machine to manufacture, and being told how many the output must be, will first make a list of the parts, being careful to include everything to the minutest screw or pin. A sample machine to dismantle is worth a thousand drawings for this purpose, and it is still more valuable in designing tools.

The manufacturer who would have tools made to conform to the drawings of a machine which has never been built hath faith to spare and "money to burn"; still it is done at least once in every man's experience. An invention, no matter who makes it, is at least one-half enthusiasm, and no tools ever made could reproduce sentiment. Before a machine is given to the tool engineer, have it a well made and perfectly operating device. The inventor will say, invariably, that "this part is a little uncertain in its motions and fails sometimes, but that is in consequence of poor workmanship. When it is made in the tools it will act with perfect reliability." Shun that machine as you would destruction; the part which fails sometimes, when poorly made, will always fail completely when well made. Never become enthusiastic over an inventor's model nor about his device until it is made off your tools and works satisfactorily; then you can divide honors with him.

Having listed the machine, begin on the bed or foundation piece and consider it for operations. What is first to be done? Having selected the bed of a lathe for illustration, we will consider that part in this relation. Shall we mill the top, or the pads for the legs, first? In planing, it is usual to rough out the top first; then turn it over. This is due to the idea that the casting will spring after the scale is cut from the top surface, and in a bed designed to save weight it is true; but such a bed could scarcely be milled. Remember, you are after commercial results, and that ideal perfection is a dream from which you awake in another shop. The pads are not important, even if you have to shim them up when the bed is turned over (and you always will have to) they will be good enough for the legs. Machine these pads first; do it from a vertical spindle on the special milling machine you have provided, with an end mill as large as the spindle will drive. Inserted teeth of Mushet steel will serve best for this cutter. Grind these teeth so they cannot scrape the surface already cut—that is, so that only the cutting points are low enough to touch the work. The advancing edges of these cutting points should be ground about 27 degrees from the horizontal and backed off as little as possible; the cutting corner should be rounded, but not more than $\frac{1}{8}$ inch.

To practical men it will seem idle to emphasize the necessity of equalizing the top surface on the table of the milling machine while the pads are being milled, but this detail is so important that the engineer should provide a fixture within which the bed shall be held at the time it is milled; one with four points of support will be sufficient. These points should be near the corners of the bed and two of them, those diagonally opposite, should be rigid and the others adjustable. To save a long description we will make a sketch of a suitable fixture for this purpose.

In this fixture the work rests upon four points of support. Two of these diagonally opposite each other are fixed, while the other two, one of which is designated *A*, are vertically adjustable by means of wedges, which wedges are formed upon a single piece *B*, long enough to pass diagonally through a slot planed in the bottom of the fixture and under both these adjustable pins or points of support. When the work is put on to this fixture it will first rest upon the two fixed points and will of course rock freely upon them. Now, by pushing in the wedge strip, the movable points are forced upward and, as the inclination of the wedges is the same and the length of the pins equal, the tops of them will always be at the same hight and consequently the work will be as nearly leveled as it is possible to make it. A setscrew may be added for holding the wedge strip in place, although if the inclination of the wedge surfaces is slight—within 7 degrees—friction will hold it securely when the clamps are tightened. Notice that the clamps are directly over the points of support. This is a law in tool designing which should be learned so thoroughly that it shall become an instinct.

In addition to the pads, both edges of the bed at the bottom should be straightened. To do this the horizontal spindle of the machine, provided with two straddle mills, should be used. This same gang of mills can be used to mill the edges of the top, which width should be looked after in the pattern for the bed.

The bolster to be used for the bed when turned over should be a simple plate about 2 inches thick, 3 or 4 inches longer than the bed and about 10 inches wider. A guide on the back side, to set the edge against, should be provided, and all the clamps and stops should be attached to the bolster. The success of the operation will depend entirely on how carefully the bed is fastened to the milling machine, provided it cannot spring in itself.

The tools for roughing the top should be small vertical cutters, to be able to operate them between the shears. With cutters like these the whole flat parts may be finished, as well as the vertical edges of the shears and the inner edges of the bed. The gib surfaces and those for the rack, etc., may well be done with end mills, upper cut. The shears should be finished in two cuts with gangs mounted on the horizontal spindles—one to rough and one to finish, as already indicated.

A suitable milling machine for this work should be as like a planer as possible in general appearance. The open-side machine is not rigid enough when cuts are taken at a distance from the support.

Layout of Corliss Valve Gears—II.

BY SANFORD A. MOSS.

THEORY OF EXHAUST MECHANISM.

Next we may consider the exhaust motion. In deciding the steam motion we have also decided the arc of vibration of the wrist-plate, and of course must design the exhaust motion for the same vibration. As the exhaust valve opens wider than the steam valve the exhaust pin must be set on a greater radius than the steam valve. The ratio will be about 3/2 in most cases, if the exhaust arm and steam bell-crank are equal. The result may also be accomplished by having the same radius for steam and exhaust pins, in which case the exhaust arm will come out about $\frac{2}{3}$ of the steam bell-crank. We first select the radius to the exhaust pin arbitrarily, either the same as the steam pin or greater, and find the exhaust arm to correspond in a manner to be described presently.

We have already found that the exhaust valve moves from line and line position to extreme opening, while the exhaust pin travels over a fraction $\frac{n'B}{AB}$ (Fig. 2) of its total motion. The valve motion for this period is evidently equal to the port width plus overtravel. We must also select a value for the maximum distance by which the valve closes the port, called "seal" as before. This need only be sufficient for security against leakage.

In the case of the exhaust there is no objection to going beyond the radial position and causing pull-back. This is in fact always necessary if the seal is to be reduced to the least safe amount in order to prevent idle travel when the valve is closed. A number of values may be found for the exhaust arm, all of which will give the desired values to the seal and maximum port opening.

There is a minimum limit to the exhaust arm, however, and any value below the minimum will not give sufficient port opening. The less the exhaust arm the quicker the port opening, however, although the variation in rapidity is very slight. Therefore the best value for the exhaust arm is the least one that gives the desired maximum port opening. This value must be found by trial and error in a manner to be described later.

If we use this least value for the exhaust arm, and have sufficient pull-back so that the idle travel is as small as possible, consistent with seal enough to prevent leakage, then the maximum angle between

the link and arm will be considerably less than the maximum safe angle.

Some builders consider pull-back objectionable even in the case of the exhaust valve. In this event the seal may be kept down by using that value of the exhaust arm which gives the desired total port opening, if we go to the radial position, and have the greatest possible maximum angle. There is but one value of the exhaust arm which satisfies these conditions. The seal will then probably be larger than necessary, but there is no way to reduce it except by passing the radial position. When limited to the radial position, if we use a smaller value for the exhaust arm than that giving the maximum safe angle, the seal is increased and the maximum angle decreased. The port opening is also slightly quicker. There is a minimum value for the exhaust arm in this case, also.

VALVE-DISPLACEMENT CURVES.

When a Corliss motion is fully designed, it is useful to investigate the port openings by means of a "valve-displacement curve." This is drawn by laying off horizontal distances corresponding to piston positions, and vertical distances equal to the corresponding port openings. Such curves are shown for both steam and exhaust valves in the lower part of Fig. 4. In the case of a valve operated by an eccentric without any distortions, the "valve-displacement curve" becomes nearly an ellipse, and is called the "valve-ellipse."

Suppose that we draw a vertical line on a valve-displacement curve, say at ⅓ of the horizontal length of the curve. This represents a piston position at ⅓ stroke, and port opening for this piston position is given by the hight of the curve at this point. The main horizontal line on the curve corresponds to the port edge, and distances on one side represent port openings, and on the other side the amounts by which the valve covers the port when closed.

In the case of the steam valve we have two separate motions, the motion of the valve and the motion of the bell-crank. The two coincide while the valve is opening. The full line curve on the steam valve figure in Fig. 4 gives the motion of the bell-crank, and the dotted curve gives the motion of the steam valve, supposing that cut-off occurred at the latest point of cut-off. The dotted portion of the steam valve curve representing the closing of the valve when pulled down by the dash-pot is a fair representative of curves found experimentally by attaching an indicator to the dash-pot rod. The closing of the valve is not instantaneous by any means, and the piston moves an appreciable distance while the valve is closing. When the valve is closed it seals the port by the constant amount shown in the figure, as the piston continues its motion. The bell-crank afterward moves back farther than the valve by the amount of the latch clearance.

The curve in long dashes on the steam valve figure in the lower part of Fig. 4 represents the motion of a valve operated by an eccentric without any distorting influence, and having the same lead, angle of advance and maximum port opening as our actual valve. It will be seen that the idle travel of this valve is very much greater and the port opening slightly more rapid. This curve would be obtained by a Corliss valve gear without a wrist plate, in which the reach-rod directly moved the steam valve. It will be seen, therefore, that the wrist-plate greatly reduces the idle travel, but also retards the port opening in an infinitesimal degree. A Corliss valve always opens more slowly than it would if there were no wrist-plate. This is shown by the fact that the Corliss displacement curve always lies inside of the curve for the equivalent direct connected valve, as in Fig. 4.

DRAWING VALVE DISPLACEMENT CURVES.

Next let us consider the theory of a very simple method by which the "valve displacement curve" is drawn. First we find the position of the steam or exhaust pin for a given piston position, and then lay off the position of the link and valve arm. The displacement of the valve arm from the port edge position, measured on the proper radius, gives the port opening. The method of finding the position of the exhaust pin for a given piston position is as follows:

Suppose we draw a circle through the extreme positions of the exhaust pin, *s* and *w*, Fig. 4, and draw a line 1—13 so that the angle from 1 to *s* is 90 degrees plus the angle of advance. Let 1—13 represent the stroke of the piston and let the circle represent the path of the crank-pin. Let *z* represent any piston position and 15 the corresponding crank position, supposing that the obliquity of the connecting rod be neglected. This is of course obtained by taking 15 on the crank circle vertically opposite *z*. The angle made by the eccentric at this time is given by a point 90 degrees plus the angle of advance ahead of 15—say at about 22. The corresponding horizontal displacement of the eccentric could be found by projecting this point on the line 1—13. Suppose that we now rotate the point representing the eccentric position and the line on which this position is projected. Let the point and line be rotated together, so that their relative position is maintained, back through an angle of 90 degrees plus the angle of advance. The eccentric position will then be brought to coincide with 15, and the line on which the eccentric position is projected will coincide with *s w*. That is to say, the horizontal displacement of the eccentric corresponding to crank position 15 may be found by projecting 15 on the line *s w*. Since the displacement of the exhaust pin is proportional to the horizontal displacement of the eccentric, the exhaust pin position is found by continuing the projection line to 15′. Therefore 15′ is the position of the exhaust pin corresponding to the piston position *z*, where the angle between *s w* and 1—13 is 90 degrees plus the angle of advance. The position of the steam pin corresponding to any piston position may be found in a similar manner.

NOTES ON VALVE-DISPLACEMENT CURVES.

In laying out the valve displacement curves as in the lower part of Fig. 4, we neglect the obliquity of the connecting rod, as has been stated. The obliquity of the connecting rod affects the two ends of the cylinder in an opposite manner, and therefore the valve displacement curves for the crank and head ends differ. A curve obtained by neglecting the obliquity will be the mean of the curves for the two ends, if the head and crank mechanism are exactly symmetrical. As the mean differs from the actual curves but slightly, we may obtain all necessary information from it.

The valve-displacement curve gives the only rational means for deciding as to the relative rapidity of port opening of different valve mechanisms. There are many ideas concerning proportions of Corliss valve gear parts which are supposed to give quick port openings, which would be shattered if valve-displacement curves were drawn for a few cases.

A good way in which rapidity of port openings may be compared is to find a single point on the valve-displacement curve. This is done by finding the percentage of piston displacement when the port is half open. For instance, the piston is usually at about 4 per cent. of the stroke when the admission port is half open. A case where half port occurred at 3 per cent. would therefore be quick port opening. The "half port percentage" may be found by finding the piston position corresponding to the given valve position in the manner just described. All of the statements of this article concerning rapidity of port opening have been found out by constructing a number of cases and finding the half port percentage in this manner.

BELL-CRANK ARRANGEMENT.

In Fig. 1 the steam bell-crank is on the upper side of the valve. An arrangement is very common, however, in which the bell-crank is turned downward instead of upward. In the case shown the bell-crank and steam-pin arcs are turned in the same way with respect to the steam link, while in the case where the bell-crank is turned down the arcs are opposite with respect to the link. There is no difference whatever in the theory of the two cases, and everything said concerning the arrangement shown applies equally well to the other.

There is a practical advantage in the arrangement of Fig. 1, in that the steam in passing from the steam pipe to the cylinder does not have to go over the steam valve, as it does when the bell-crank is turned down. Some friction loss is thereby avoided.

DRAWING-BOARD PROCEDURE.

We have now gone over the whole of

the theory of the design, and will proceed to discuss the methods used in working out the design on the drawing board. In giving the methods to be pursued we will omit the reasons for the steps as they have have been given in full in the foregoing.

Fig. 4 represents the completed layout. The most convenient scale is usually half size. Only the head-end valves need be attended to, as the mechanism is symmetrical. Compute the port widths by the formulas already given, allowing about 8,000 feet for steam and 6,000 feet for exhaust velocity.

Lay off the center of the wrist-plate at the center of the cylinder *O*. This is customary but not necessary. Lay off the piston in the position at the end of the stroke. Lay off the cylinder ports so that the piston just clears them, or covers them slightly. Often the outer edges of the ports are opposite and the piston just clears the steam port and slightly covers the exhaust port. Lay off the vertical center line through the valve seat bores. This may be through the center of the exhaust port, as in Fig. 4, or placed so the cylinder ports are inclined, as in Fig. 1. The cylinder ports should join the valve seat bore at or near the vertical center line. Often both ports meet the valve seat bore so as to be equally divided by the vertical center line. Then the valves for the two ends may be alike instead of being right and left.

Decide the valve seat bore, taking it about one-quarter the cylinder diameter. It is usually rather more for small engines and rather less for large ones. Lay off the horizontal center lines through the valve seat bores so that there is sufficient metal between the valve seat bore and the cylinder counterbore, say, about the same thickness as the cylinder walls, or slightly more. Both valve seat bores are usually placed at the same distance from the cylinder center, both ways, for convenience.

Lay out the main exhaust port either, at the side of the exhaust valve, as in Fig. 4, or below, as in Fig. 1, according to the design of the cylinder.

Draw in the wrist-plate circle, taking the radius of the steam pins as the cylinder radius or thereabouts. The exhaust pin radius may be the same or somewhat greater, as desired.

STEAM MECHANISM.

Draw in the bell-crank radius, taking it about 2½ times the valve seat bore radius. Values differing considerably from this may be used, however, in order to utilize patterns and drawings on hand. Draw an arc with radius .7 of the bell-crank radius. The extreme position of the steam link is to be tangent to this arc and the maximum angle will then be 135 degrees. If a greater angle is deemed permissible, the radius may be reduced somewhat. A circle .5 of the bell-crank radius gives an angle of 150 degrees, which is an extreme value. Draw an arc $A' L'$ with radius equal to that of the valve seat bore, full size. The angles through which the valve moves may be found by laying off the proper distances full size on this arc. Lay off the lead from I' to J', full size. The lead will vary from 1/16 inch in small engines to ¼ inch in large ones. It may be taken at about 1/16 of the port width in designing the mechanism. It can be readily changed by altering the length of the steam link when the engine is set up. Lay off the steam port from J' to K', full size. Lay off the overtravel from K' to L', full size. This will be from ⅛ inch in small engines to 1 inch in large ones. The greater the overtravel the quicker the port opening. A common assumption is ¼ of the port width. Draw radial lines through J' and L'. $J L$ will then be the amount that the bell-crank must move from the lead position to the maximum opening.

Select the desired percentages of release and compression from the data already given, taking release from 98 to 99½ per cent. and compression from 90 to 98 per cent. Express these as decimal fractions and subtract them each from 1.00. Multiply the numbers thus obtained by the diameter of the steam pin circle. Lay off the distances resulting from c' to i' and k' respectively. Thus, in the case of Fig. 4, where release is 99 per cent. and compression is 96 per cent., we take $c' i'$ equal to .01 and $c' k'$ equal to .04 of 12″. Project i' and k' horizontally to i and k and take j midway between. The angle $c' O j$ is then the angle of advance. Project j vertically down to j'. The ratio $I' j'/I' l$ then gives the mean of the latest points of cut-off, and also the fraction of the stroke of the steam pin passed over when the steam valve is in the lead position.

Take $c' n$ equal to $i j$ and project vertically to n'. Then $I' n'/I' l$ is the fraction of the stroke of the exhaust pin passed over when the exhaust valve is in the line and line position. This we will use later.

FIRST TRIAL FOR STEAM MECHANISM.

We may now determine the steam valve mechanism, by trial and error. That is to say, we will guess at a solution and see how it works out, then find a second one which gives a closer result, and so on until a solution is found which gives a result sufficiently close to the desired one. The values to be determined are the extreme positions a and g of the steam pin and the length of the steam link. The conditions to be satisfied are that $g G$ shall be tangent to the circle previously drawn, that $a A$ shall be the radial position or slightly beyond it, and that the bell-crank shall move the distance $J L$ while the steam pin moves over the proper fraction of its stroke. We proceed as follows:

Take a trial value of the point g at random and draw $g G$ tangent to the circle of .7 of the bell-crank radius. Set off the steam link length $g G$ on a beam compass and find a such that $a A$ is the same as $g G$ and A is out as far as possible on the arc. Then draw $A O$, marking the intersection with the steam pin circle. This gives the exact radial position. Then lay off A exactly by setting the steam link length off from the radial position. Select a point just inside A, which is to give the amount of "pull-back," if any is to be allowed. The latch clearance may be about 1-32 inch on the arc $A' L'$ and the pull-back should be somewhat less than this.

From this point lay off the steam link length, thus exactly determining a, the extreme position of the steam-pin, slightly below the radial position. Draw $a g$ and take $l' m''$ equal to it, laying the line $l' m''$ off at about a 30-degree angle. Draw $l m''$ and draw $j' m$ parallel to it. Take $g e''$ equal to $l' m$ and draw $e'' e$ perpendicular to $a g$. Then e is the position of the steam pin when the steam valve is open by the lead. Set off the steam link length $g G$ from e to E. Then $E G$ should be equal to $J L$. If it is not, the assumed motion does not give the desired amount of overtravel and a new trial must be made.

FURTHER TRIALS FOR STEAM MECHANISM.

Assume a new value of g slightly nearer a if the overtravel was too large, and farther away if it was too small, and repeat. Repeat the work successively until values are found such that $E G$ is nearly equal to $J L$. The line $l m''$ first drawn may of course be used for all of the trials and the successive values of $a g$ laid off from l' so as to meet it.

When a fairly satisfactory solution is obtained, draw radial lines through A, and E to A' and E'. Lay off the latch clearance and lead full size, respectively from A' and E'. The distance $B' D'$ between the points thus obtained is the seal. This will usually be found more than sufficient for safety against leakage. If, however, it is not sufficient, a new solution must be found in which the radial position is not reached.

A safe value for seal is ⅜ inch in small engines to ¾ inch in large ones. Usually the seal turns out too great and there is no way to reduce it, as the maximum angle cannot be increased, nor the radial position further exceeded.

The angle at G between link and bell-crank will of course be safe from the method of construction. The angle at A should be tested and seen not to be too sharp. It should not be less than 45 degrees. In most cases it will be found considerably on the safe side. However, if the port width and valve seat bore are such that the bell-crank moves through too great an angle, the angle at A may be unsafe. In this rare event, increase the valve seat bore and begin all over again.

LOCATION OF STEAM PIN.

Next locate the point c midway between a and g. The chord $c c'$ is the distance from the topmost point on the steam-pin circle to the steam pins on either side. Occasionally this distance becomes so small and the steam pins so close together that there is no room for the stub ends of the two steam links. The distance may

be increased by decreasing the bell-crank radius or increasing the steam-pin radius. Such changes will also decrease the seal very slightly, but will have no other effect.

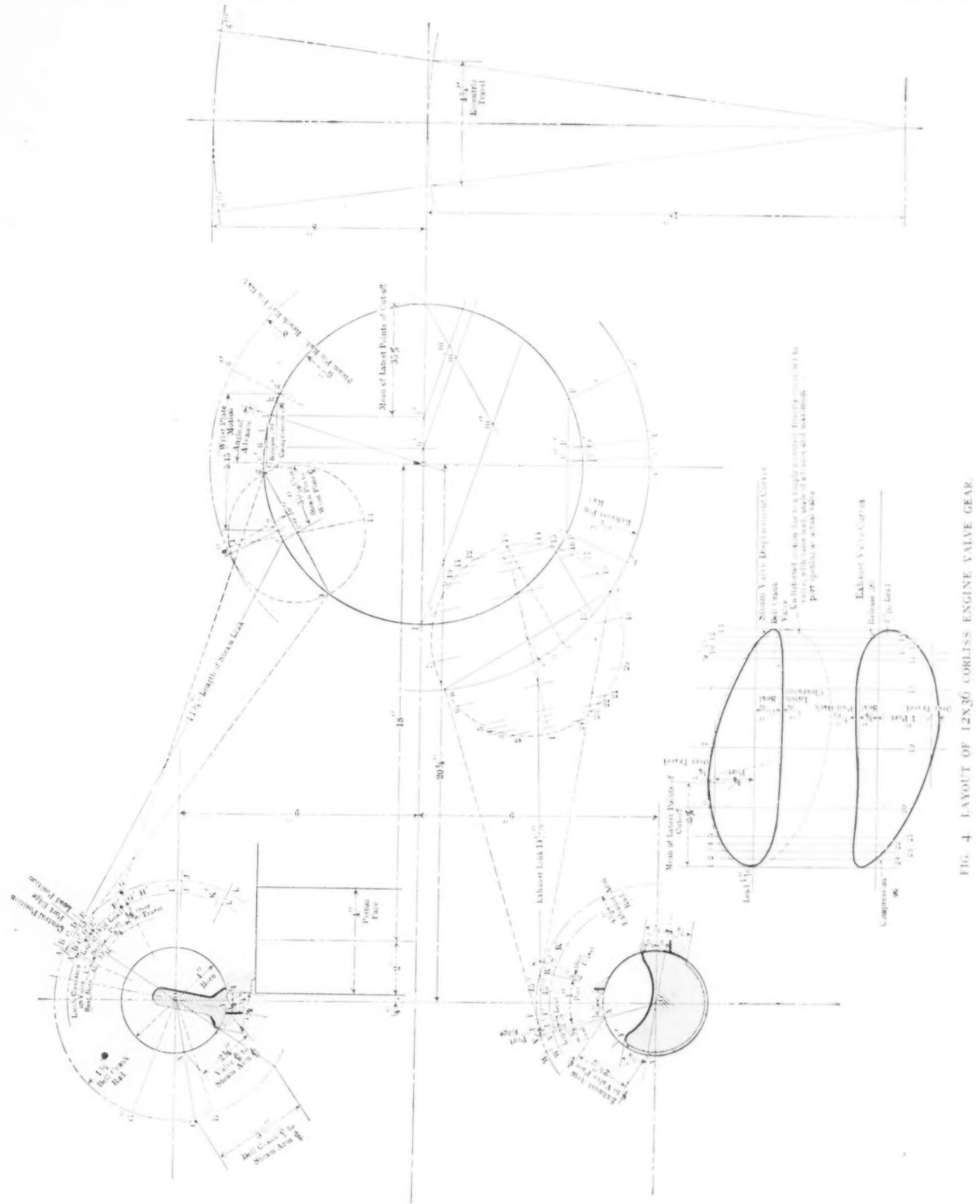

FIG. 4. LAYOUT OF 12X30 CORLISS ENGINE VALVE GEAR.

The steam pins may also be separated by turning the bell-cranks down.

In the case of very large cylinders with relatively short strokes, it is not possible to separate the steam pins sufficiently in the top of the wrist-plate. The valves then open by motion of the wrist-plate opposite to that shown, and the radial position becomes the inner extreme of the motion of the steam-pin. There is no essential difference in the method of procedure when this type of motion is used.

Having arranged so that there is sufficient room between the steam pins, measure the chord $c\,c'$ and the steam link length $G\,g$ and take the nearest shop dimensions as the final values for these quantities.

DETERMINATION OF ECCENTRIC.

Measure the chord $a\,g$, multiply by the

ratio of the reach-rod-pin radius to the steam-pin radius, and then by the ratio of the length of the rocker arm from eccentric rod-pin to rock-shaft to the length of the whole arm. Select the shop dimension nearest to the result as the final value for the eccentric travel.

The reach-rod-pin radius is often the same as the steam-pin radius. By taking it slightly greater, as is often done, the throw of the eccentric is increased and the eccentric pressure reduced.

The top of the rocker arm must be level with the reach-rod pin and the eccentric rod must be attached to the rocker arm on the engine center line. The rock shaft may be taken at any convenient distance below the center line. The distance to the reach-rod pin and to the rock shaft may be varied if desirable, so as to make the eccentric travel have any desired value. Having decided the eccentric travel, divide by the two ratios before used and work back numerically to the exact travel of the wrist-plate and steam pin. Lay out the vibration of the rocker arm and of the reach-rod pin as indicated, noting that the chords $a'''g'''$ and $a''g''$ must be equal.

FINAL STEAM MECHANISM.

Draw radial lines locating a' and g'. The chord $a'g'$ should scale the same as the calculated value for the travel of the wrist-plate. Lay off the previously decided value of $c\,c'$ as a chord from a', c' and g', thereby finally locating the points a, c, g, which are the central position and the two extreme positions of the steam pin. Lay off the final value of $a\,g$ from l' to m'', and locate the final position of e. Lay off the final value of the link length from g, e, c and a, and locate the final positions of the points G, E, C and A. Draw radial lines locating G', E', C' and A'.

The drawing usually shows the mechanism in the central position, so that $C\,c$ and $C\,O'$ are to be drawn in full lines. Lay off the lead from E' to D', the latch clearance from A' to B' and the port from D' to F'. The seal is then given by $B'\,D'$, the lap by $C'\,D'$ and the overtravel by $F'\,G'$. The working edge of the valve covers the port by the seal in the extreme position, at which time the other edge of the valve is nearest the port. Hence the total face of the valve must be the seal desired with this other edge, plus the port plus the seal $B'\,D'$.

Lay off $F'\,H'$ equal to the seal desired with the further edge of the valve, full size. Then $B'\,H'$ is the width of the valve face, full size.

The valve may now be drawn in so as to cover the port by the lap, and have the width above determined.

The total motion of the steam arm is $B\,G$, and if it is to be horizontal in its middle position, as is usual, half of the arc $B\,G$ is to be laid off above and below the horizontal, giving B'' and G''. These are then the extreme positions of the steam arm. The position of the steam arm for the central position of the wrist-plate is found by taking $B''\,C''$ equal to $B\,C$. The distances from the steam arm to the valve center line and to the bell-crank are to be given for the use of the draftsman who makes the details of the various parts.

EXHAUST MECHANISM.

The steam valve is now completed and we may proceed with the exhaust valve. Fig. 4 shows the general case where the exhaust pins are on a greater radius than the steam pins. This is done for the sake of increasing the exhaust arm. As has been stated, in the case where the steam and exhaust pins are on the same radii the exhaust arm comes out about $\frac{2}{3}$ of the steam bell-crank. Therefore, if the exhaust arm is to be of the same length as the bell-crank, as is sometimes desired, the exhaust-pin radius must be about 3/2 the steam-pin radius.

The exhaust-pin radius is first to be decided and laid out. Lay off the final value of $l'\,m''$ (equal to $a\,g$) on the steam-pin circle, from p to p''', half on each side of the vertical center line. Take $p\,p'$ equal to $l'\,m$ and $p\,p''$ equal to $l'\,m'$. These points give the fractions of the stroke of the exhaust pin when the exhaust valve is open by the exhaust lead and when it is line and line. Draw $p'\,q'$ and $p''\,q''$ perpendicular to $p\,p'''$ and draw radial lines through p, q', q'' and p''', locating s', t', u', v', w'. The latter points are the positions of the point on the exhaust-pin circle half way between the two exhaust pins, when the wrist-plate is in the position for the following events: extreme port opening, piston at end of stroke, valve line and line, central position of wrist-plate; extreme port closure.

We have now to decide the distance $s'\,s$ from the point midway between the exhaust pins, to the exhaust pin; the length of the exhaust link, and the radius of the exhaust arm. This is done by trial and error as follows: First let us suppose that it is permissible to go beyond the radial position in the case of the exhaust link.

FIRST TRIAL FOR EXHAUST MECHANISM.

Assume a trial value for the exhaust arm, about $\frac{2}{3}$ of the steam bell-crank if the steam and exhaust pins are at the same radius, equal to the steam bell-crank if the exhaust-pin radius is 3/2 of the steam-pin radius, and proportionately if between. Assume a trial value for the distance from the half-way point to the exhaust pin $s'\,s$, and locate the extreme and the line and line exhaust-pin positions s, u and w by laying off $s'\,s$ from s', u' and w'. Assume the link length $s\,S$ and lay off the exhaust-arm positions S, U and W. Draw radial lines and locate S', U' and W' on an arc whose radius is twice the valve seat bore radius. The distance $W'\,U'$ should be a safe amount for seal when the valve is closed and the distance $U'\,S'$ should be the port width plus overtravel. As in the case of the steam valve, the seal should be from $\frac{3}{8}$ to $\frac{3}{4}$ inch, according to the size of the engine. The seal may be taken at about 1/32 the port length. The overtravel is usually made the same for the exhaust as for the steam valve. The seal and maximum opening will probably not come out correctly at the first trial. By lengthening the chord $s'\,s$ the seal will be reduced without materially affecting the maximum port opening, while by lengthening the exhaust link the port opening is reduced without materially affecting the seal. By thus changing the two lengths appropriately, the desired seal and maximum opening may be secured after several trials. The originally assumed value for the exhaust arm is to be retained during all of this time.

FURTHER TRIALS FOR EXHAUST MECHANISM.

As stated, lengthening the exhaust link in general reduces the total opening. However, there is a limit to this, and after a time, lengthening the exhaust link will increase the opening. That is to say, there is a certain value of the exhaust link which gives a minimum value for total opening, for each exhaust arm. This minimum opening occurs when the exhaust link is of such a length that the exhaust arm is about perpendicular to it when the port is half open. If in the trial solution obtained this minimum value for the total opening is still greater than desirable, the assumed value of the exhaust arm is too small. In this event, assume a new value for the exhaust arm, slightly larger than before, and do the trial work all over again as before. Repeat the trials successively until a value for the exhaust arm is found such that the minimum value of the total port opening is the desired amount. This is the best possible value for the exhaust arm.

On the other hand, the desired seal and total opening may have been obtained with the first value assumed for the exhaust arm. The solution thus found will be satisfactory, except that the port opening will not be quite so rapid as would be obtained with a smaller exhaust arm. If it is desired to secure the greatest possible rapidity of port opening, the value of the exhaust arm such that the minimum value of the total opening is also the desired value, is the best exhaust-arm value to use, as already stated. In order to find this value we proceed as follows: First see if increasing the exhaust link length reduces the total opening appreciably. If it does not, the solution is already the best possible. If it does, reduce the exhaust arm and work out a new solution, obtaining the desired seal and total opening, as before. Again see if increase of exhaust link reduces the total opening. Repeat successively until finally a solution is obtained such that increasing the exhaust link causes no appreciable change in the total opening.

METHOD IF FULL-BACK IS NOT WANTED.

In case it is not deemed permissible to pass the radial position, we proceed in a somewhat different manner. In this case

we go exactly to the radial position and secure the greatest possible maximum angle between the exhaust arm and the link in the maximum opening position. This usually gives a greater amount of seal than necessary for safety against leakage, but this cannot be avoided without passing the radial position. The method of procedure is as follows:

Assume a value for the exhaust arm, and also for the chord $s' s$ and the steam link. Correct the values for the chord $s' s$ and the steam link, by trial and error, so that the radial position is reached and the desired maximum port opening obtained. When these conditions are satisfied test the maximum angle. If it is too great, reduce the exhaust arm slightly, and if not as great as possible, increase the exhaust arm slightly. Make successive trials in this way until a value of the exhaust arm is found which gives the desired maximum angle. When limited to the radial position values of the exhaust arm less than the one above indicated and giving less maximum angles than the greatest one permissible, will give satisfactory solutions. However, the seal will be larger than need be, although the port opening will be slightly quicker.

COMPLETION OF EXHAUST MECHANISM.

Having by some one of the methods indicated located the points W, U and S satisfactorily, we proceed as follows: Lay off the determined value of the chord $s' s$ from t' and v', locating t and v. Lay off the link length and locate T and V, which are the exhaust arm positions for the piston at the end of the stroke and the wrist-plate in the central position. $V'' U''$ is therefore the exhaust lap and $U'' T'$ the exhaust lead—full size, of course.

Lay off $R' R''$ equal to the seal desired when the farther side of the valve is nearest the port. $W'' R''$ is then the necessary width of valve face, except when the pull-back is considerable, when it must be slightly more. Lay off the exhaust valve so that it closes the port by the exhaust lap. The exhaust valve is often given a much wider face than the necessary amount determined above, in order to keep it from rocking.

VALVE-DISPLACEMENT CURVES.

Next we may draw the valve displacement curves. Draw circles on $a g$ and $w s$ as diameters. Draw c 1 perpendicular to $a g$, and draw the diameter 1—13 of the steam valve circle. Draw t—13 perpendicular to $w s$ and draw the diameter 13—1 of the exhaust circle. The procedure following is the same for both steam and exhaust, and we will only indicate it for the case of the exhaust. Divide the line 1—13 into quarters, divide the first and last quarters into eighths, and divide the first and last eighths into thirty-seconds.

Project the points thus located on the circle, as from z to 15. Draw 15—15′ perpendicular to $w s$, and so on for each of the other points. 15′ is then the exhaust pin position corresponding to the piston position z. Lay off the exhaust link length from 15′ to 15″ and draw a radial line locating 15‴. The distance from U' to 15‴ then gives the amount that the valve is open when the piston is at z. Locate all of the other corresponding points.

Draw the horizontal lines of the valve displacement diagram which represent the piston stroke. Take the horizontal scale $1\frac{1}{2}'' = 1'$. Divide this piston stroke just as the line 1—13 is divided and number the divisions as indicated in the lower part of Fig. 4.

Lay off vertically on each piston division line the port opening corresponding, full size, measuring from the port edge line as indicated. Of course exhaust arm positions on the left of the port edge line represent distances by which the valve closes the port. The two valve displacement curves may next be completed as indicated in Fig. 4. The dotted and dashed curves of course need not ordinarily be drawn.

Cornell University.

Engineering Reminiscences—X.

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BY CHARLES T. PORTER.

In the summer of 1861 I made application for space in the London Exhibition of 1862, and soon after was waited upon by the Assistant United States Commissioner, Mr. Joseph E. Holmes. So far as the engine to be exhibited was concerned, I had nothing to show Mr. Holmes. The drawings were scarcely commenced. I, however, took him to McLaren & Anderson's shop and showed him the little engine at work there and took diagrams from it in his presence, and expatiated on the revolution in steam engineering that was there inaugurated, but which has not yet been realized to the extent then dreamed of. It was evident that Mr. Holmes was much impressed with the assurance of the success of the new system that the perfect running of this first little engine seemed to give. I told him that the engine for the Exhibition would certainly be completed, and on that assurance he accepted my entire proposed exhibit. I did not see him again until we met the next spring in London under the somewhat remarkable circumstances hereinafter to be related.

In spite of all efforts it was found impossible to complete the engine and have it tested before shipment, as I had intended. Indeed, as the time approached after which no further exhibits would be received, two things grew more and more doubtful. One was whether the engine could be got off at all, and the other whether I could obtain the means to make the exhibit. Finally I managed to get the engine bed finished and immediately shipped it off by a mail steamer.

A small, slow steamer chartered by the United States Commissioner and loaded with exhibits had sailed previously, carrying the assistant commissioner and a number of exhibitors and their representatives, who until they reached their destination remained in blissful ignorance of what happened directly after their departure.

But, to return to my own movements. A friend said to me: "I understand you shipped your engine bed last Saturday; what did you do that for? You don't know yet whether you can go yourself." I replied: "If I had not shipped it then, I should lose my space and would have to abandon the exhibition altogether. If I find that I can't go, the bed can come back." I redoubled my exertions to get the remaining parts of the engine completed and to raise the necessary funds. The next Saturday I shipped everything that was ready. On the following Monday, by making a large sacrifice, I realized a sum that could be made to answer, and on Wednesday I sailed on the Cunard steamer "Africa," leaving to my clerk, Alexander Gordon, now president of the Niles Tool Works, the responsibility of seeing that everything still wanting should follow as rapidly as possible.

I left, not knowing an Englishman in the whole island, to have the parts of an engine, the first one from the drawings and the first engine I ever made, brought together for the first time by I had no idea whom, and assembled and put in motion before the eyes of the world. But I had no misgivings. The engine had been built in my own shop, under my constant supervision, and by workmen trained to the greatest accuracy. The crank-pin I had hardened and ground by my friend, Mr. Freeland. I knew the parts would come together perfectly. The result justified my confidence.

One incident of the voyage is worth recording. As we were leaving port we passed the "China," the first screw steamer of the Cunard fleet, coming in on her maiden voyage. We had some rough weather, sometimes with a following sea. I was much interested at such times in watching the racing of the engines, when occasionally both paddle wheels would be revolving in the air in the trough of the sea. The feature that especially attracted my notice was that the faster the engines ran the more smoothly they ran. It was certainly a fascinating sight to see these ponderous masses of metal, the parts of great side lever engines, gliding with such velocity in absolute silence. The question what caused them to do so it did not occur to me to ask.

I reached London very early one morning, and drove directly to the lodgings of my friend, Mr. Wellington Lee, the only American resident in London whom I knew. Who was Mr. Lee and what was he doing in London? These were questions in which I had an interest of which I was as yet entirely ignorant. The firm of Lee & Larned were the first successful designers of steam fire engines in this country. More than seventy of these steamers had been built from their plans

and under their direction by the Novelty Iron Works in New York, and the fire department of that city was completely equipped with them. One of these engines had been sold to the city of Havre, and Mr. Lee had gone over with it to test it publicly on its guaranteed performance. Mr. Amos, one of the senior members of the great London engineering firm of Easton, Amos & Sons, went over to Havre to witness this trial, with a view to the manufacture of these steam fire engines in London. So it came to pass that at this particular time Mr. Lee was in London superintending the first manufacture of his engines by this firm.

After our salutations Mr. Lee said: "First of all I have something to tell you." Before relating this, I must mention something that I knew before I sailed. About the time when the cargo of United States exhibits started, the well-known Mason and Slidell incident occurred. These gentlemen, commissioners sent by the Confederacy to represent their cause before European governments, sailed on a British vessel flying the British flag. This vessel was overhauled on the high seas by one of our cruisers, and the commissioners were taken off and brought prisoners to New York. Mr. Lincoln made haste to disavow this illegal proceeding, so singularly inconsistent with our own principles of international law, and to make all the reparation in his power. But a bitter feeling towards England was then growing in the United States, and in a moment of resentment Congress hastily passed a resolution repealing the law creating the Exhibition Commission and making an appropriation for its expenses, and Secretary Seward issued a proclamation dissolving the commission. The vessel carrying the exhibits had been gone scarcely more than a day when this action of Congress and Mr. Seward surprised the country.

I now take up Mr. Lee's narrative. The news of this action, carried by a mail steamer, had reached London several days before the arrival of the exhibits. Under the pressure of an urgent demand the Royal Commission confiscated the space allotted to the United States and parceled it out to British exhibitors. Mr. Holmes on his arrival found not a spot in the Exhibition buildings on which to set his foot. But he was a man of resources. He went before the commission with an eminent Queen's counsel, who made the point that they had received no official notification of any such action by the United States Government, but had proceeded on a mere newspaper rumor, which they had no right to do; and there was the United States assistant commissioner with his credentials and a shipload of exhibits, and they must admit him.

The commissioners yielded most gracefully. They said: "Now, Mr. Holmes, the American space is gone; we cannot restore that to you, but there are unoccupied spots all over the Exhibition, and you may take up any of these, and we will undertake that your whole exhibit shall be well placed." Upon this Mr. Holmes had gone to work and had been able to find locations for every exhibit, except my engine.

"But only yesterday," said Mr. Lee, "Mr. Holmes learned that an engine ordered by the commission to drive the British exhibit of looms, of which there were thirty-three exhibitors, had been condemned by the superintendent of machinery, Mr. Daniel Kinnear Clark, and ordered out of the building." He added that Mr. Holmes went directly to Mr. Clark and applied for the place for my engine, the bed plate of which luckily had arrived and was then on a truck waiting to be unloaded. In answer to Mr. Clark's questions, Mr. Holmes had given him his personal assurance that I would be there, and the engine would be there in ample time, and would be all that he could possibly desire; and on that assurance he had got the place for me.

I informed Mr. Lee that I also had got something to tell *him*. I then gave him the situation as already related. He looked very grave. When I had finished he said: "Well, you are in a hole, sure enough; but come, let us get some breakfast, and then we will see what Easton & Amos can do for you." After eating my first English mutton chop in a chop-house on the Strand, I accompanied Mr. Lee to their works in the Borough. None of the partners had yet reached the office. Very soon Mr. James Easton arrived. Mr. Lee introduced me and told my story. The instant he finished Mr. Easton came across the room and grasped my hand most cordially. "That's the kind of pluck I like," said he; "we will see you through, Mr. Porter; we will build this engine for you, whatever else may have to wait." Directly he added: "We have a good deal of 'red tape' here, but it won't do in this case. There will be no time to lose. Come with me." He then took me through the shops, and introduced me to every foreman, telling them what he had undertaken to do, and gave each of them the same instruction, as follows: "Mr. Porter will come directly to you with his orders. Whatever he wants done, you are to leave everything else so far as may be necessary, and do his work as rapidly as possible."

As I listened to these orders, I could hardly believe my senses or keep back the tears. Coming on top of the devotion of Mr. Holmes they nearly overcame me. The sudden relief from the pressure of anxiety was almost too much. This whole-hearted cordiality of the first Englishman I had met gave me a high idea of the people as a whole, which, I am happy to say, a residence of over six years in England served only to increase.

Returning to the office, we found Mr. Lee, who said, "Now, Mr. Porter, I think Mr. Holmes would like to see you." Getting the necessary directions, in due time I found myself in the Exhibition building on Cromwell Road and in the presence of Mr. Holmes, who received me joyfully and led me at once to Mr. Clark's office. As he opened the door, Mr. Clark looked up from his desk and exclaimed, "Good morning, Mr. Holmes, where is that engine?" "Well," replied Mr. Holmes, "here is Mr. Porter, and the engine is here or on the way." Mr. Clark asked me a number of questions about the engine, and finally how many revolutions per minute it was intended to make. I replied, "One hundred and fifty." I thought it would take his breath away. With an expression of the greatest amazement he exclaimed: "What, a hundred and fifty! B—b—b—but, Mr. *Porter*, have you had any experience with such a speed as that?" I told him my experience with the little engine, which did not seem to satisfy him at all. Finally he closed the matter, or supposed he had done so, by saying: "I cannot allow such a speed here; I consider it dangerous." I decided instantly in my own mind not to throw away all that I had come for, but I made no sign, only asked what speed I might employ. After a little consideration Mr. Clark replied: "One hundred and twenty revolutions; that must not be exceeded." This he considered a great concession, the usual speed of stationary engines being from fifty to sixty revolutions. I meekly acquiesced, then made my plans for one hundred and fifty revolutions, and said nothing to anybody. I had no idea of the gravity of my offence. It was the first time since I was a child that I had been ordered to do or not to do anything, and I had no conception of orders except as given by myself. If there was any risk, I assumed it gaily, quite unconscious how such a daredevil defiance of authority would appear to an Englishman. Mr. Clark showed me my location, and gave me an order for my engine bed to be brought in immediately, and also other parts of the engine as soon as they arrived. Trucks generally, I was told, had to wait in the crowd about ten days for their turn to be unloaded.

I hurry over the time of erection. Everything arrived promptly and the whole came together without a hitch, as I knew it would. The flywheel and pulley and cylinder lagging I had left to be made in England. I was at the works of Easton, Amos & Sons every morning at 6 o'clock, and laid out the work for the day. I made the gages for boring the flywheel and pulley, which I had now learned how to do and adjusted everything about the engine myself, and knew it was right.

I had a talk with the foreman of the pattern shop about the best thickness of felt on the cylinder to be covered by the mahogany lagging, in the course of which I remarked, "It is the air that is the real non-conductor." "Yes," he replied, "and felt, you know, is *'air.'*" I learned several things I did not know before, among others how the English made a steam-pipe joint, using parallel threads and a backing-

up nut, with long hemp and red and white lead putty.

I had great luck in the way of a driving belt. An American exhibitor of india rubber belting asked the privilege of exhibiting a belt in use on my engine, which I was glad enough to have him do. Otherwise I hardly know what I should have done. The widest English belts were 12 inches wide, double, and sewn together from end to end with five rows of sheepskin lacing. The belt ran on the knobs of this lacing. The ends were united by lapping them about two feet, and sewing them through and through with this same lacing. Fine pounding these joints would have made on the pulleys. I got a governor belt from him also. Both belts were united by butt joints laced in the American fashion. I learned afterwards that I should have had a sorry time driving my governor by a belt laced in the English way.

In spite of all efforts and all our good luck, we were not ready to start until a week after the opening day, May 1, and the exhibitors were in despair, for none of them believed that this new fangled American trap would work when it did start at the frightful speed of a hundred and twenty revolutions per minute, which they had learned from Mr. Clark it was to make. Finally one day, after our noon dinner, I turned on the steam, and the governor rose at the speed of one hundred and fifty revolutions precisely. It was immediately surrounded by a dense crowd, every man of whom looked as if he expected the engine to fly in pieces any instant.

It was not more than two minutes after it started when I saw Mr. Clark coming from his office with his watch in his hand. The crowd opened for him, and he came up to the engine and watched it for some time, walking around it and observing everything carefully from all points of view. He then counted it through a full minute. At its close he turned to me and exclaimed, "Ah, Porter—but," slapping me on the shoulder, "it's all right. If you will run as smoothly as this you may run at any speed you like.

And so the high-speed engine was born, but neither Mr. Clark, nor I, nor any human being knew then what it was that made it run so smoothly.

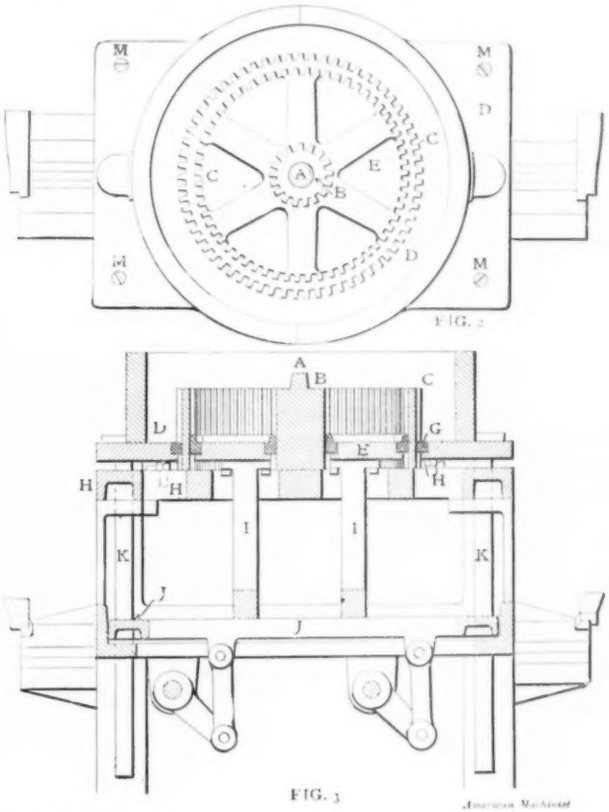

FIG. 2

FIG. 3

THE FARWELL STOOL PLATE MOLDING MACHINE.

The Farwell Stool Plate Molding Machine.

The special feature and advantage claimed for the machine shown in the half-tone, Fig. 1, is that the patterns at all times rest on the rigid frame of the machine and the stripping plate is raised, thus stripping the pattern. It is claimed that with the ordinary stripping plate machines it has been impracticable to properly press the sand because the patterns are supported upon joints subject to wear and which spring under the pressure. The operation of the machine will be understood from Figs. 2 and 3, which are a plan and a vertical section, respectively, of the machine with a pattern of an external and internal gear mounted upon it and a flask in position. In Fig. 1 the pattern and stripping plate and flask are removed. The hub *B* and the rim *C* of the pattern rest upon the pattern frame *H* at all times, and this pattern frame is fastened to the machine. The stripping plate *D* rests upon adjusting studs *L*, and the stool plate *J* also rests upon adjusting studs, so that when the sand pressure occurs everything is solidly supported. Stripping plate *D* is fastened to rods *K* by small screws in their upper ends. Rods *K* act as guides for stripping plate and stool plate, and also connect them so that they move together. Stool *E* is supported by legs *I* fastened to stool plate *J*. After the sand is pressed, the lift lever in the front of the machine is brought up, lifting the stool plate *J* and all that travels with it, and the pattern is stripped, the flask being raised at the same time. The spokes of the wheel in this case are fastened to stool *E* and follow the stool up when stripping the rim and hub, the spokes being flat, so that the flask is easily lifted clear of them. Babbitt metal *G* is used to make the stripping plate fit the pattern. The machine is made by The Adams Company, Dubuque, Iowa.

Tin as an alloy of aluminum is to be used with caution, as it seems generally to develop brittleness. It is said that sheets composed of equal parts, by weight, of tin and aluminum so ductile as to be easily rolled have become as brittle as glass after a few days.

The Objects of Technical Education.

BY C. L. GRIFFIN.

The recent communications on technical education which have appeared in the columns of the AMERICAN MACHINIST are interesting. I always have a feeling that each spasm which the technical press has on this subject is productive of some good even though it is not apparent on the surface in every case. Everybody seems to feel better after having had their little say on the subject. The practical fellows like to have their fling at the technical school, and talk about theory and practice and how far apart they are, and criticise the professors, and patronizingly declare that they are doing the best they know how, and usually wind up by saying that the technical graduates are good fellows in spite of their terribly impractical training, and that they eventually turn out all right.

Now, many good suggestions are brought out in these discussions, and the professor who is willing and quick to catch on to a good idea doubtless profits by these earnest talks of his practical brethren. They oftentimes encourage him, too, in the feeling that he is doing exactly what his shop friend would like to have him do.

The professor, however, seldom speaks for himself on this matter. I suppose it is because he feels that everything has been settled for him, and he, being out of practice, is behind the procession anyhow, and the best thing for him to do is to saw wood, try to catch up and keep quiet.

Just see, for a moment, what is laid out for him. The steam-engine men want courses in each of the many special types they represent, the pump men likewise, and then follow on the men of gas engines, locomotives, sewing machines, bicycles, air compressors, automobiles, machine tools, hoists, electric machinery, cranes, etc., etc., machinery without end. Each talks from his own specialized experience and asks for full courses on the processes affecting his specialty. Why shouldn't the technical school teach the design of hair clippers and sewing machines and the making of tools for the same? Why not have a thorough course in the organization and management of rolling mills, and the production of automatic nail machinery? And the professor, to be broad, you know, often obediently takes a literal interpretation of these questions, tries to give complete courses in each of the many industries brought to his attention, and with what result? The man who builds windmills pops up and clamors for a course on windmills, says technical graduates are no good because they don't know anything about windmills. There you are again back where you started, and where you always will be if such a plan is followed.

Now this sort of misunderstanding is what spoils technical education, ruins the professor, and the student with him, and loses the respect for the technical school of the very men who are making the complaints and yet whom the technical school is trying to serve. These practical men, I know from experience, are often right in criticising the technical graduate, but they put it in such a way as to permit of misinterpretation. The professor often partakes of the narrowness of the words of complaint, loses a broad, liberal view of things and fails to accomplish results.

The teaching of pure practice alone is worse than the teaching of pure theory alone, from an engineering standpoint. The teaching of things is nothing; the teaching of methods is everything. The teaching of how to design and build machinery is of value only in proportion as it is used as an illustration of method, not of isolated things. Finally, it is not the graduate with a brain crammed to confusion with endless details of specific things, with a spigot to flow and unlimited data on call, which the engineering world is calling for. Our manufacturers do not expect or desire that a technical graduate be a cold-storage plant, an information trust, or a corner on facts, although we are often led to think so. What they do expect instead of this is a man with a clear head, with a scientifically organized piece of brain machinery, with a sound conception of mechanical business, with a wit to tackle new problems, and solve them practically; not by reason of having had identically the same problems as exercises in college, but because his technical education, first of all, gave him pure, sound and fundamental theory, and then was devoted entirely to a limbering up process which enabled him to stand up confidently for himself, and work with intelligence when work is given him.

Such graduates the world snaps up and appreciates; they rise rapidly and bring credit to their *alma mater*, their professors and themselves, and the practical business man who employs them never thinks of asking whether they had a course in his specialty or not, and he has no reason to care.

Good engineering is a practical mechanical habit of mind, backed up by sound theory. The college gives the theory well, usually. It may as successfully develop the mechanical habit of mind if it creates the same spirit and atmosphere about its students as they will meet with in their subsequent experience. It takes practical engineering men as instructors to do this, men who have been under the manufacturing pressure themselves, and yet who realize the value of the fundamental things in engineering education. Under such circumstances the laboratory, the shop, the drawing-room, the seminar, the lecture-room conferences will be utilized properly. The habits of mechanical experiment, observation, analysis, judgment and positive action thereon, which are the instructive traits of the engineer, will then be the heritage of the student from his *alma mater*. While the technical college will always serve the purpose of an available resource for advanced research, yet its main primary function of fitting men to do the engineering work which the world offers them, however varied its character, will have been fulfilled. We may still teach windmills, or nail machinery, or sewing machines, or what you will, but in the doing of it let us make mechanical minds, not mere data recorders.

Having had my say, if the editor will give me a few lines more I will make a confession. I am myself a professor, and, as such, open to the condemnation of the species. In the ten years of routine shop experience following my college graduation I had my own troubles as a technical graduate, as well as in supervising the work of other technical graduates, in a varied line of engineering work. Since going into the "professor business," I have seen a number of classes of my own manufacture go out into the world. I know from experience with them, both before and subsequent to graduation, that men who were taught methods and not things, and who had thereby acquired a mechanical habit of mind rather than stored-up data, went with perfect confidence into lines for which their course had made no special preparation, and yet were markedly successful. The reason to me is plain. One of my boys, who has gone into marine engineering, wrote to me the other day that he had some problems given to him which even his boss didn't seem to know much about. Well, the young man said nothing, took the job, studied his best on it, and soon had something to show. The boss added his mature experience, the case was thoroughly thrashed out between them, and the problems were soon solved in a practical, mechanical fashion. The boss was satisfied, the young man was pleased and possessed of increased engineering confidence. He writes that he is not afraid to tackle anything they give him now. What more can an employer ask? What higher tribute to technical education than that? What else than a knowledge of how to go about the solution of an entirely new problem enables us to solve it? What else should we teach than a theory to stand on, and a working business method of utilizing the theory, not for any *special* purpose, but for *any purpose whatsoever?*

A single mind is a very small thing as a storehouse, but as an automatic thinking machine its possibilities are almost limitless. I believe the chances are better for refining the brain machinery than for increasing its storage capacity, for a man's head is only about so big anyhow.

Syracuse, N. Y.

The big planer in the shops of the C., B. & Q. R. R., at West Burlington, Iowa—a $10,000 machine with four cutting tools—is run by a machinist who is eighty years old, and who has not missed a day's work from sickness in ten years. He has enough to live on, but prefers to work.

A Modification of the Premium Plan.

BY W. H. BOOTH.

I have never been able to fall into line with the arguments about piece-work and premium systems of doing work. In simple piece work there always has been trouble, because an error in fixing a piece rate enabled men sometimes to earn very high wages, and these high wages were looked upon as excessive, and rates were cut down until finally it was only by superhuman toil that men could earn day wages. Human nature being what it is, a reaction followed, and men who found they had a soft snap in a good price became cautious and refused to turn out more work than they felt assured would not lead to a cut rate. To a great extent, therefore, the piece system introduced the very evils it was intended to abolish, and no doubt in frequent instances the output per man was less than it would have been on day rates.

The trades unions here set themselves against piece work, and I would not say they did not have ample justification, for the inherent difficulties of the principle have been very great. Employers who have cut rates after once fixing them have ruined the system. They all begin with very high notions of allowing a man to earn a lot of money. "Better for us and better for him," they say; but as soon as he has begun to do the earning, they have grudged him his share and gone back on their arrangements. Americans over here are worse than Englishmen and there must be a screw loose in the way piece work has been arranged, and, personally, I never found an employer who would abide by his own terms of payment on results when the results happened to exceed his anticipations. I take it that there has been some difficulty with the piece-work system in America as here, though I quite realize that possibly the fixing of rates has been more carefully done. In an ordinary piece-work rate where a man is paid, say, 6 cents for each piece, he earns as many times 6 cents as he does pieces, and if he contrives to do three times the day rate on which prices were supposed to be fixed, he earns three times the money, and it is in these cases that trouble begins. Hence the premium system, which allows him so much time to do a piece of work and pays him part of the saving he makes, the remainder going to the employer. This, in essence, is after all simply a sort of piece work, in which the workman pays back part of what he earns over and above a certain sum. It is not put down as so much being paid back, but that is what it amounts to. It is, after all, based on a correct method of fixing the time necessary to do the work, and if an error has been made, the man only gets the benefit of part of the error, and the risk of dispute is, by so much, deferred.

To a reasonable extent workmen ought to be protected against themselves, as ought everyone in the best interests of the general community; for it cannot be good that a man should work himself into the hospital, as many men will do, by striving to earn the last possible cent.

Pending our general perfection, some system should be available, which, while increasing a man's pay for more work, will decrease the risk of rousing the employer's greed and his tendency to say to the man, "You are earning too much money," which is at the bottom of all piece-rate cutting. What is wanted, therefore, is a system which will tone down the errors that have been made in fixing rates; which will be simple to apply as a flat rate per piece or per dozen; which will give a man a reasonable and substantial advance for increased production; which will limit his loss or his gain within comparatively narrow limits, will check the greed of the more ungenerous employers and not punish the more generous and will put a check upon excessively hard work by the men.

In the accompanying table are three lines of figures representing a man's earnings in dolars on the basis of $10 for day rates and for piece-work rates of pay when he is doing from one to five times the day-rate number of pieces:

1.	1.25	1.5	1.75	2	2.5	3	3.5	4	5
$10.00	$12.50	$15.00	$17.50	$20.00	$25.00	$30.00	$35.00	$40.00	$50.00
10.00	11.20	12.25	13.25	14.00	15.80	17.30	18.70	20.00	22.30
10.00	10.78	11.45	12.05	12.60	13.60	14.40	15.18	15.90	17.10

The first line contains the number of pieces done per week or the number of dozens or scores or other unit.

In the second line is the man's earnings on a flat piece-work rate on the basis of $10 for the minimum number per week he should be competent to do.

In the third line is given the man's earnings on the basis of a rate fixed by multiplying the $10 by the square root of the number in the top line.

In the fourth line is the same result found by employing the cube root. This idea is only put forward as a suggestion of what may be worked upon in the direction indicated. Thus, by the square-root rule, the man earns 22½ per cent. if he does 50 per cent. above minimum. If the rate has been badly fixed so that he does four times the minimum, he will earn double pay.

Taking the cube-root method an increase of 50 per cent. gives him 14⅓ per cent. additional and an increase of fourfold gives him not quite 60 per cent., the latter after all not a very terrific increase.

Moreover, to earn another $1.20, he must do 25 per cent. more work, so that as the good pay is earned the inducement to earn a comparatively small amount more is hardly sufficient to induce overworking. A further line of fourth roots would show only $15 for a fivefold production.

It seems to me that this system, say, with the basis of the cube root of the production, would with certain modifications effect the end desired. In the Fig. *A B* is a line of work done, and *C D* is the curve of square roots drawn originally to a scale of ⅛ inch = 1 dollar. *C H* similarly is the curve of cube roots. The line *E F* is simply drawn at an angle across the base line *A B* as a suggested base line from which to scale off the hight of the line *C D* so as to add a proportion to the lower rates of premium in which most reasonable rate fixing will find the men working, as it seems to me, that on a square-root basis the man who does, say, 50 per cent. extra work, does not increase his pay quite enough and at the very high figures due to possible big mistakes it sub-

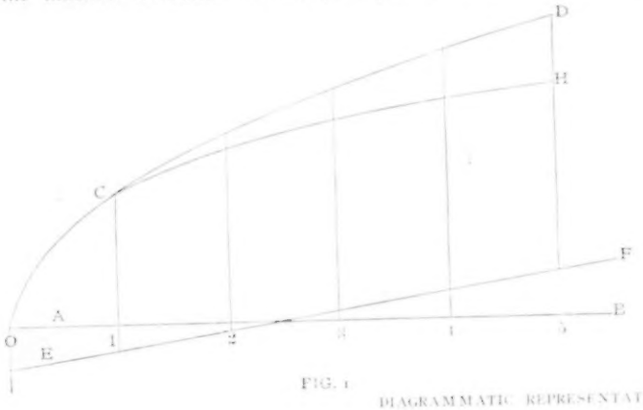

FIG. 1

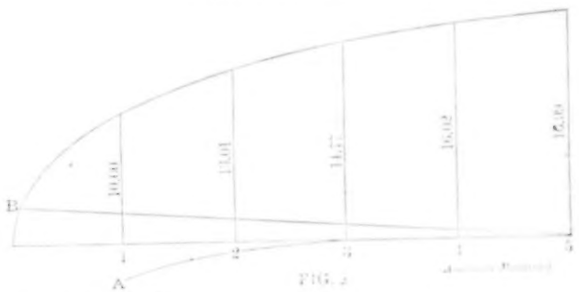

FIG. 2

DIAGRAMMATIC REPRESENTATIONS OF THE INCENTIVE.

tracts a further correction. In any case, such a diagram carefully drawn to whatever basis may be selected, will be very easy to use as a wage calculator.

In Fig. 2 a curve very similar to a curve of cube roots in the lower numbers up to 5 is found by multiplying each number by 10 and finding the full logarithm. Ten times this is the vertical at each point. Thus for double production the log. of 2 is 0.301; the log. of 10 times 2 is 1.301, and this is the ratio of the pay for double output to day rate. In Fig. 2 the ratio is converted into dollars on the basis of 10 dollars for the day-rate pay. Such a curve is very near the cube-root curve. Thus the cube root of 5 is 1.71; that of 2 is 1.26. The logarithmic curve is a better curve to use, for it keeps down the figures above 5 and increases those lower down and can be corrected by a sloping base line which may be itself a curve as at *A* 3 in Fig. 2.

All business is practically conducted along curved lines, and not upon straight lines. This is not intended to read ambiguously. For example, in all sales a larger quantity usually merits a lower price and a man who undertakes to machine so many articles at certain rates will be content to earn along a sliding scale of some sort, for he knows that when extreme errors have been fixed on certain pieces of work he cannot be employed very long at the heavy rate because of the competition of the man in the next street. By the logarithmic system he finds himself getting some benefit from the error, yet he makes really but a small addition as between an output of 4 and 5; yet he earns 30 per cent. additional by doubling his output.

The sloping line *B* 5, in Fig. 2, is so drawn that the vertical at point 1 is cut off at 80 per cent. If now used as a base line to the curve as found already, it will result in a double production, adding 40 per cent. to earnings; or it might have been drawn parallel with the base line and then would have increased the earnings on the higher production somewhat less than the increase given by the sloping correction. Any drawing-office curve may be used, if the curve it gives is seen to be able to give results which everyone agrees will be about right. What I want to show is that mere straight-line "curves" are apt to tempt people to very crooked dealings and that the gradually yielding curve tends to preserve a balance between contending interests, and while it does not destroy the incentive of a man to turn out the utmost product per square foot of the floor space he occupies, it urges him to do so without fear of a cut being made and at the same time does not urge him to the point of doing work beyond his powers of accuracy or proper physical endurance. The principle is that of the sliding scale which has acted well in the coal-mining districts, where wages were fixed for years by the market price of coal, and strikes were averted.

[It seems to me that Mr. Booth does fall very effectively into line with the piece-work and premium-plan argument. He states the argument against piece work very effectively in his first paragraph, and then explains a plan which has the essential features of the premium plan, the only difference being that it gives less and less of the gain due to increased effort to the workman as the output increases. It seems to me that this is the opposite of equitable. To save the first hour on a long job is comparatively easy—it is the last hour saved that requires thought, effort and ability. If there is to be any change in the incentive as production increases, it seems to me that it should be increased rather than diminished.

Except, however, for the situation introduced by the introduction of new methods, the discussion is chiefly academic since, except when such methods are introduced, the extreme rates of increase, extending up to fivefold, on which Mr. Booth's diagrams are based, are not experienced. Mr. Booth's, like Mr. Rowan's, method makes it feasible to continue the original rate after such a change in production methods and, as I understand him, this is Mr. Rowan's chief claim for his method. In this respect it seems to me both gentlemen are wrong. When new production methods are introduced, it is equitable and proper that there should be a readjustment of the rates. Moreover, after their introduction there is no good reason why the workman should not have the same incentive—that is, the same reward for saving an hour—that he had before, but by the methods of division proposed by these gentlemen it is just at this point that the incentive begins to fade away.

From Mr. Booth's standpoint of protecting the workman against himself his plan is fatally defective. With one job the limit of possible output will be found at an increase of 25 per cent. over day's work production—the protective feature of Mr. Booth's method having not been approached. With another job this limit may be at an increase of 100 per cent. and with another, under new production methods, at 500 per cent. It is clear that no curve such as those given can suit any large proportion of cases, and its application to any one case will be a matter of accident only.—F. A. H.]

Grinding.

H. Darbyshire, foreman of the universal grinding machine department of the Alfred Herbert shops at Coventry, England, read a paper recently before the "Workmen's Institute" connected with that establishment, on the subject of "The Grinding Machine and its Possibilities." The paper is published in *The Engineer*, and from its columns we abstract a few paragraphs.

. . . . . .

"Perhaps the most important thing pertaining to successful grinding is the question of temperature, and I have often thought that this may be the reason why this method of finishing work is not more popular. Grinding without water gives very unsatisfactory and discouraging results, and it is only within the past few years that makers of this class of machinery have done much in this matter, as the revised construction of their machines will show. The late Mr. Taylor, of Messrs. Brown & Sharpe—who were perhaps the pioneers in this thing—told me that their earliest machine had nothing but a tin of water below the wheel to catch the dust. A sud can over the wheel was an improvement, then a very small pump and tank. The latest machine I know of holds a hogshead of water, and delivers 50 gallons of water per minute at the grinding point. Messrs. Landis condemn the plan of using the same water continuously, they arguing, with reason, that the water becomes greasy and dirty, and interferes with the wheel's efficiency. They condemn the use of soda for similar reasons, and advocate a continuous supply from the public mains. I have certainly got the best results from pure, clean water, and should never use soda, if it were not for fear of rusting the machines. In grinding any cylindrical job, dry, it will be found that its axis is constantly changing, and if heavier cuts are taken, it will appear to be, and in fact is, out of truth to a more or less extent, from the fact that at the grinding point the heat is the greatest, and is constantly varying, and it will be found impossible to get a true job unless means are taken to equalize it. Hollow spindles and other tubes only aggravate the trouble, as there is less mass to absorb the heat generated. A good stream of water will always cure this, except in the case of tubes thin in section, when it is often found necessary to fill them and plug the ends. As an illustration of tube grinding, you may imagine a tube with oval hole, measuring 4 inches diameter; bore, say, 3½ and 3¾ inches. If ground without filling with water, it will probably measure .0005 oval on the outside, the smaller place being at right angles to the smaller diameter of bore. My opinion is so strong on these points that I dare venture to assert that it is an impossibility to get round and true work without water. Added to that, the production is as three or four is to one against the dry machine.

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"Straightening hardened work I have found is generally a waste of time. You may, by heating to a temperature that is not hot enough to soften, be able to so true the job that it will clean up to finished dimensions, but it will almost certainly go back, although it may be weeks after. I have seen cases that would illustrate this in work from firms whose reputation is above question. It seems to be the best thing to soften, straighten and then reharden. In soft work you have the same trouble in a lesser degree, though the distortion seems to depend much upon

the previous machining. It may seem almost incredible, but it is a fact that work that comes from the bar lathe frequently gives more trouble than work done on centers. It has been suggested that in the bar lathe —heavy reductions being the rule—there is not the same apparent necessity to true the stock before turning, and that on grinding away the hard skin left by the steadies the previous distortion develops. If this is the reason it would seem to show that bars should be straight before commencing to turn. As I said before, I do not really know the reason, but I think that it is good matter for discussion and experiment. A shaft that has sprung during turning and then been straightened will resume its bent form again more or less after a slight reduction has been made. It is a good plan to first spring it over the opposite way, and then straighten it. It will be found that in the majority of cases it will remain straight if this has been done.

. . . . . .

"It should never be imagined for a moment that grinding a job is a guarantee of its quality. As a rule, a sample of ground work looks very nice with its clear, sharp corners, and uniformity of finish, it looks just as pretty when .001 inch below size. You can spoil work on a grinding machine, as well as any other machine, by want of thought, which is the usual reason for scrap, and the man at the wheel is sometimes an 'absent-minded beggar.'

"I have often heard the expression, 'Oh, it's all right; it's been ground,' which is paying the grinder a compliment he does not always deserve. I have also heard it said, 'Oh, it's good enough; it's got to be ground.' Now I do not want to preach a sermon, and commence by saying that carelessness in one thing leads to carelessness in others, but I will say that the turner can ease the grinder in many ways that will be quite obvious to him.

"I have tried to show that an extra few thousands do not matter much, but good centers are indispensable, and those without broken drills in are the best."

[In this matter of good centers, we might add that very many shops need education, and probably there are far more of them proportionately in England than here. It ought to be obvious that it is useless to provide accuracy in the spindle bearings and movements of a grinder or lathe and then provide centers for the machine and for the work which do not fit each other at all, and which cannot possibly maintain the same axis of rotation from the beginning to the end of a job as centers should. —Ed.]

In America engineers believe not only in commercial advertising, but in making as widely known as possible all the technical details of their manufactures, *a practice we shall eventually be compelled to adopt on this side.—Engineering Times*, London.

Numbering and Filing Drawings.

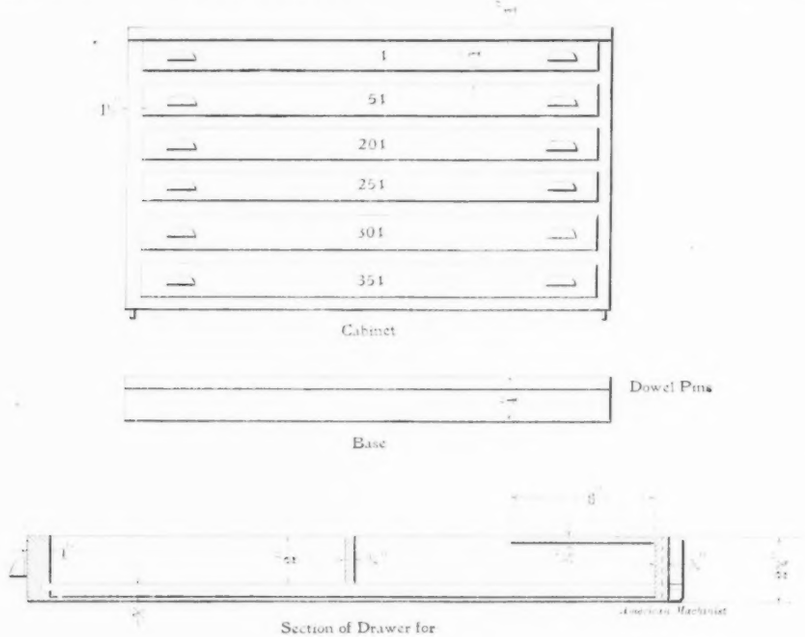
BY S. A. WORCESTER.

Having observed, during a varied experience, the workings of many different numbering and filing systems and passed through divers and sundry troubles with their weak points, an outline of a good system and a brief comparison with some other methods may be useful to some of the readers of the AMERICAN MACHINIST.

I will first notice some of the failings of one or two of the systems which I have observed. One method which I encountered used a three-part symbol, thus: K-13-91. This symbol indicated the class, K, of the machine; the drawer, 13, in which it was filed, and the number, 91, of the drawing in that class. Experience showed, among the faults of this system, that there were many mistakes made in drawing numbers, also that when cabinets and drawers had been fitted up for the different classes of machines and the sections lettered and drawers numbered, there were many drawings made in one class and few, if any, in some of the others; so that some sections soon filled up and ran over, while others had much unused room or were perhaps empty. Then when more room became necessary in any one section, the extension involved moving a large number of drawers ahead, or renumbering them, perhaps both. The scheme is not elastic, and any enlargement is apt to call for a general rearrangement. I have heard a letter and number system strongly favored, in which the letter indicates the class of machinery or drawing and its corresponding filing section. This scheme has the same faults as the one just mentioned, although in less degree. It has twice the liability to mistakes that a single number has, and experience has shown that there is great likelihood of mistakes every time a number is repeated with different letters. I1 and J1 sound and look much alike, and E2 and B2 and D2 and G2 look and sound more or less alike, and practice has shown that many mistakes occur with either a letter and two numbers or a letter and number. The letter and number index is also more complex and is not as convenient for enlargement as the simple number index. Most drawing rooms use a number of different sizes of sheets, and it is common practice to use, with the number, a letter indicating the size of the sheet. A 9x12 drawing may be numbered K325; a 12x8, M617; an 18x24, S071, etc., etc. The letter is practically useless outside of the drawing room, and of very little use inside, and has the same tendency toward complexity and mistakes that I have emphasized before. The system which I recommend for numbering drawings, and which I have used with much more general satisfaction than any other, is one using simple consecutive numbers. Just at this point the letter system advocate breaks in and says: "But your number doesn't give you any idea of what the drawing is or what class of machine it shows. Now, if you just give your engine drawings the letter A and your machine tool drawings the letter B, etc., etc., you always know about where to find an engine drawing or a machine tool drawing by its letter and don't have to hunt through an index for it." To this I reply that I have found it quite as easy to reserve numbers in fifties or multiples of fifty as to add the letter; and as no number is repeated, the danger of mistakes is avoided, and my index uses simple consecutive numbers. But there is small gain in keeping all the drawings of a class of machines together, although it is easy in designing a single machine to reserve enough numbers in the index so that the drawings of the machine are consecutive. While at first the use of the letter may seem a convenience, and as long as the number of classes or letters and drawings is small, one familiar with the system can find the drawings easily by the letter; yet when the number of drawings and letters becomes larger and new draftsmen come, it becomes more troublesome to find drawings by the letter and number than by the simple number. But in laying out a scheme for numbering and filing drawings indefinite extension should be borne in mind. The manager of a small concern says, "Oh! It'll be a long time before we'll need room for more than 1,000 drawings, and when we do have to enlarge we'll manage some way." So he builds cabinets and numbers drawers and letters classes and sections, using perhaps ten letters to start with and allowing, say, 100 drawing numbers and two drawers to each letter. After a short time the A drawers are nearly empty, because he stopped building corn-shellers after the first lot, and the G section of index and drawers is full, because mowers are built in increasing numbers and styles, and more room must be made for G drawings. One of the H drawers must be changed to G to make room, but the H drawers are nearly full, also the I section, and he has to take the first one of the J drawers, which is nearly empty, and mark it "I" and move down all the drawings in H and I and mark the first H drawer G and the first I drawer H. The index book doesn't admit of this kind of change, so room has to be taken at the back of the book, where there are some blank leaves, say on page 201, and a note written at the end of the G numbers: "Additional G drawings on page 201." After four or five years' business six or eight sections have been enlarged in this manner, and the matter of relettering and renumbering drawers and extending the index becomes a nuisance, and the index gets into very bad shape, and it is only a short time until the whole scheme must be rearranged or become an endless annoyance.

The use of the letter for indicating merely the size of sheet requires a separate index for each size of sheet and repeats the

numbers with the different letters. The arrangement of drawers also becomes disconnected with considerable waste room. In general, I have found that the simple consecutive number system, for all drawings, irrespective of size, has less complication, less liability to mistakes and less waste room, both in index and drawers, than any other method. When it seems desirable to keep all the drawings for a machine together it is easy to reserve as many numbers as are needed by a pencil notation in the number index, and if the first reserved number is a multiple of 50, it is as easy to remember as a letter. Drawers for holding tracings should be made for the large or standard size sheet, which should cut drawing paper and tracing cloth from the roll with the least possible waste. Smaller sizes of sheet should be made, each by cutting the next larger in two. Standard size drawers can



A CASE FOR FILING DRAWINGS.

then be partitioned nicely for the smaller sizes of sheets. Fifty standard size or 100 half size or 200 quarter size drawings make practical numbers for the contents of a drawer. Supposing the first drawer to be used for 50 standard size tracings and the second for 50 half size and 100 quarter size and the next for standard tracings, I would then mark the drawers 1, 51, 201, 251, 301, 351, 401, etc. The three numbers, 51, 101, 151, might be shown on the second drawer, but in practice they are of small value. Stamped brass or metal label holders for holding a number card make a nice appearance on the drawers. In ordinary engineering practice probably 90 per cent. of the drawings made are on standard sheets, so that few of the drawers need partitions. The number index should give, after the number, the title, date and name of the draftsman. Any other small items may be added that may suit the case in hand. They should be pencilled lightly in the index as soon as the pencil drawing is finished and written in ink when the tracing is finished and checked. The title index must be for the best results, a well-kept card index, which, like standard drawers consecutively numbered, allows indefinite extension. The cabinet for holding drawings can be made sectional, with interchangeable drawers, the main sections of one tier having perhaps twelve or fifteen drawers, and the upper section having six or eight drawers. The sides of the cabinets should be flush so as to stand close together in the vault or drawing room. Each section should have four dowel pins in its lower side, for holding it in place on the base or other section on which it rests. Partitions for the drawers may be ⅜ inch thick and the drawers may be 1½ inches longer and wider inside than the standard sheet. The ⅜x6-inch cover shown in the section of the drawer is necessary to keep tracings from rising over the back of the drawer. The sides of the drawer may be ¾ inch thick and dovetailed to the front. Some engineers make a practice of destroying a tracing from which perhaps one or two prints have been sent out, and giving the same number to a new drawing which supersedes the first one. This practice is almost certain to result in expensive and troublesome mistakes. It is unsafe to send out prints from a new drawing having the same number unless a correct record of prints has been kept and it is certain that all prints from the old drawing have been destroyed. Even then I do not consider it safe or wise to give the new drawing the same number as the old one and destroy the original tracing, for two reasons. First, I have known of several cases in which the workman has saved an old print and when he received orders to finish some work by a drawing of that number he got out his old print, saying nothing to the foreman and finished his work by it instead of taking the trouble to get the new and revised drawing. A change in the number would have avoided these mistakes. In the case of work contracted for by a distant concern, to which a print from the original drawing has been sent for a bid and the new drawing with the same number sent later for getting out the work, it is easy to see how a foreman having a written order specifying the drawing number may use the older print and make mistakes costing thousands of dollars. Second, sketches are sometimes made in the shop, from prints and saved and used to duplicate a future order for some piece from a given drawing. In this way I have known of several cases of workmen who, having a certain drawing number given them, used sketches which they had copied from the old drawing of the same number instead of using the new and revised drawing. The result was a mistake of a more or less serious character. When in charge of shops I found it necessary, on this account, to forbid workmen using sketches of their own and insist on their always having the proper drawing at hand. There is also the objection to this practice of destroying tracings that a record of original work, which, although apparently useless, sometimes becomes of great value, is lost. Keeping the original and giving the new drawing a new number is the best method, I think, of avoiding all danger of these mistakes.

[We cannot let the chance go by without remarking that the partitions between the drawers of the cabinet might be omitted and the space which they occupy be saved. —Ed.]

A Good Job.

The following incident occurred a short time ago at the Baldwin Locomotive Works:

Mr. Vauclain, the general superintendent of the works, was riding on a freight elevator, which stopped at one of the floors to take on an old Irishman. A rule of the establishment forbade workmen using the elevator unless they had a heavily laden wheelbarrow. This man had none; so Mr. Vauclain accosted him, saying: "Don't you know that you are not allowed to ride on this elevator without a wheelbarrow?" "Sure, and where's your wheelbarrow?" responded Mike, not at all abashed. "Why, I am the general superintendent," exclaimed Mr. Vauclain. Very confidentially the old son of Erin leaned toward him and said, in a patronizing manner: "Then ye've got a blamed good job and ye'd better hould on to it."—*Philadelphia Ledger.*

This reminds us that at the Brown & Sharpe Works, in Providence, there is an

elevator on which no wheelbarrows are allowed. It is for employees whose duties require the 1 to go from one floor to another, and was put in because it is believed that it is a waste of energy and of time for an employee to devote them to the work of lifting himself up flights of stairs and letting himself down again.

Letters From Practical Men.

Warped Celluloid Triangles.

Editor American Machinist:

Referring to Mr. E. J. Towndrow's article, at page 161, I rather doubt whether it is wise to straighten draftsmen's triangles. I have used celluloid triangles, better known as set squares, for these last seven years. One of my squares is warped. I have never tried to straighten it; the reason is this: I find I can keep my drawing far cleaner with it than with one that lies flat to the drawing paper. I think nearly every one who has used set squares will agree with me when I say that celluloid triangles take the place of all others, and an improvement would be to have the squares thick at the edges and gradually get thinner towards the center, similar to a concave lens. The squares would then only touch the paper at the three edges and would not be apt to rub the dirt into the paper.

I suppose, if one wished to *make* a set square warp, it could be done by following the suggestion of the above gentleman.

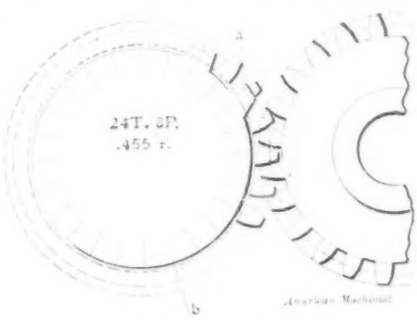
Manchester, Eng. SAGO.

Drawing Gear Teeth—Keeping Drawings Clean—One Way to Make Blueprints.

Editor American Machinist:

One of the tedious things a draftsman has to do is to repeat a given line, or outline, a number of times on the same sheet. Especially is this true if the draftsman wants to do something more than make lines. The particular job I have in mind is the drawing of teeth on a gear or rack. Now, in imagination, I see every member of the craft that reads this article throwing up his hands and saying, "Why should the *tedious job* be done, when all that is necessary is the pitch circle, or, at most, a few teeth where the gears are in contact?" Yes, that is all that is required, and all I ever put on working drawings, but how about the Patent Office drawings, and the man that makes drawings for exhibition, by the inventor, to the capitalist, who perhaps could not read a working drawing, pure and simple, but could see through it if it was brought out more like a picture.

I had to make a drawing of the latter kind a short time ago. It was quite a good-sized machine, with eighteen spur and six bevel gears in it, with from twenty-four to sixty teeth each, and I drew in the conventional pitch circles, and was getting well along with it when the inventor came in and espied those gears. No go; I must draw teeth on them, and dot in all hidden teeth. I looked at those pitch circles and got tired right off. To space off all those gears, even with a protractor, and lay off all those centers for the tooth profiles, was no small job to contemplate, so I set about to devise some means of simplifying the process. I drew the addendum and root circles, to determine the top and bottom of the teeth. Then I took a piece of bristol board and drew the pitch, addendum, root and base circles, and divided for the number of teeth, drawing a radial line for the center of each tooth. I then found the radius for the teeth profiles from an odontographic table, and laid out one tooth, pricking the centers *a* for the radii permanently in to the base circle. I used but one center for the tooth profiles,



DRAWING GEAR TEETH.

as that looked near enough right. Next I cut out the cardboard as shown in the illustration, cutting slightly smaller than the root circle, and leaving the centers on the base line on the card, as shown, cutting out the space between them in which the teeth are drawn. I took a handled needle, such as described by Frank B. Kleinhans at page 1655, Vol. 25, and put this through the center of the cardboard templet, and the gear to be drawn. I drew a radial line *b* from the edge of the templet; then, with compasses set to radius, turned the templet to bring each division on it to match the radial line on the drawing, and described the tooth profile, first from one center and then from the other. After the first gear is drawn, the radial line *b* will have to be located to bring the tooth in the space of the other gear. You will see there was a big saving in laying out, even on one gear, and where there are three or four of a kind, as in my case, the saving was great.

The same principle can be applied to other figures of symmetry about a common center, such as ratchet wheels, designs, etc., in which case it might be necessary to cut the outline on the templet, as might have been done with the gear teeth; but I decided it would be more satisfactory to work from the centers. This may not be new, but I have never seen it used.

One other thing Mr. Kleinhans writes about, in the article referred to, is dirty drawings. Dust will settle on drawings, winter or summer, and I find that the T-square rubs more dirt in than the triangles. The way I overcome this is to paste thin blotting paper on the under side of the T-square. It does not slide as easily, but it picks up the dirt instead of rubbing it in. This is a trick resorted to by Patent Office draftsmen.

I ran across a queer case this winter. A young man came to me, saying he was doing the drawing for the —— Company, and wanted information about blueprinting. He was not having much success. Said he never took a lesson in drawing, but he could make a working drawing of any machine. He asked which side of tracing cloth I used, and several other questions. I let him do the talking, for I saw he had not reached the real point yet. Finally, he asked if I made the tracings the same as the print I wanted. He said he did at first, but the prints all came left handed; but he had overcome that difficulty all right. I asked how. He said he made the drawing, then put the tracing cloth on with the dull side up, traced the drawing with a lead pencil, turned the tracing cloth over and inked the other side, making a left-hand tracing. He said he was getting quite expert at making letters and figures backwards.

He was surprised when I told him to put the ink next the glass, and the blueprint paper on the back of the tracing. He said he had a camera and supposed the blueprints had to be exposed in the same position as photographs.

Next he wanted to know if work was to be done outside—whether I sent out the tracing or blueprint. His practice was to send the tracing and keep a print of it. I did not ask, but suppose in such a case he made a right-hand tracing and kept a left-hand print. He certainly showed ingenuity, although misapplied, in overcoming an obstacle. C. L. G.

The Photographing of Drawings.

Editor American Machinist:

Referring back to Vol. 24, at page 1109, I noticed an article by Mr. H. D. Van Doorn, wherein he explains a way of photographing down tables and diagrams of interest to be put on file. I agree with the editor that the cost in time and money of his method must be considerable.

As an amateur photographer, I am always interested in anything in that line and wish to say a word about the time of exposure. I have never been able to find a plate slow enough to be exposed four minutes on a drawing, and for a long time I have been using only one kind of plate for different purposes.

The best results in photographing drawings were obtained by exposing only two seconds in a well-lighted drawing room, using a diaphragm small enough to render all lines sharp. I use an ordinary developer, but the bath the same as for instantaneous work. I send you herewith two prints. The negative of No. 1 has been exposed in the drawing room as explained above; that of No. 2 is a snapshot taken in full sunlight.

I am photographing all our machines and drawings with a 5x7 camera with a rectilinear lens, and we are satisfied with the results. CHAS. NUSSBAUM.

Nancy, France.

[Of the two prints sent by our correspondent, No. 1 is much the better, all lines in the drawing being brought out in this print very clearly.—Ed.]

Stamping Medals.

Editor American Machinist:

I have read with interest Mr. Woodworth's article, "Coining at the New Mint at Philadelphia," at page 56. It leaves quite considerable to the imagination of the reader as to how the various coins are made, the tools used for the same, etc. It has not been my pleasure to have been

FIG. 1. SAMPLES OF MEDALS.

employed by the government in this particular line of business, but it puts me in mind of several years when I was employed as toolmaker by a concern that makes a specialty of all kinds of small medallions, especially those used throughout the world by the Catholic Church, and of which I send you several samples that I had at home. They are made of aluminum, brass, copper, gold and silver, as occasion requires, and may come under the same category as coins, as similar machinery and tools are used in their production.

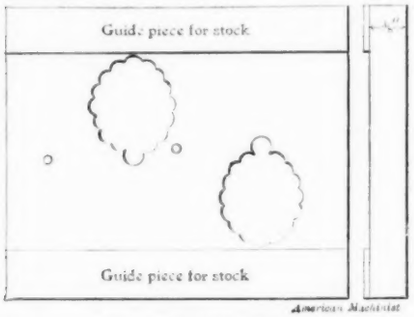


FIG. 2. BLANKING DIE.

We will take the most common or "scalloped" style, as in the half-tone, Fig. 1, mostly made of aluminum, but sometimes of silver or gold. The aluminum used for this style is rolled just wide enough to blank two rows and perforate at the same time, and usually the roll is about 200 feet long.

The blanking die is made as at Fig. 2, is usually about ⅜ inch thick to insure uniform hardness throughout, is worked out with barely any taper at all and is

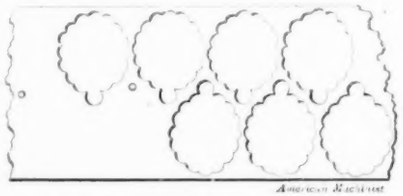


FIG. 3. APPEARANCE OF SCRAP.

fastened to the die-block with screws and dowel-pins. The punches (except the small perforating punches) are left soft and fastened in the usual way in a steel block or plate and fastened to the punch-holder with screws and dowel-pins. The common spring stripper is used, attached to the punch, leaving the die perfectly clear with only the guides for stock and scrap, Fig. 3.

The press was an ordinary No. 19 Bliss, equipped with a ratchet feed roll (single plan), operated from the crank shaft, "home made," easy to adjust for the various sizes and usually blanked about 175,000 a day. The blanks were then dipped, cleaned of all dirt and oil and sent to the embossing department, which consisted of several presses.

Considerable trouble was experienced at the start to overcome the wear, and especially the sinking, by the continual compression of the die-block at the base of

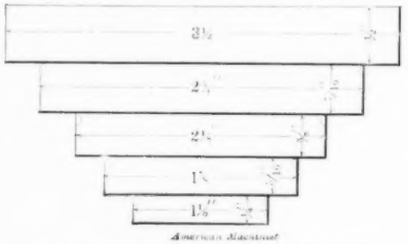


FIG. 4. CENTER BLOCK OF DIE BOLSTER.

each die, and after considerable experimenting the die bolster was made of steel, bored to take a hardened and ground steel center with five steps, as Fig. 4, which proved satisfactory in every respect.

The dies (two for each medallion) were made of the very finest hammered tool steel, were when finished 1⅝ inches diameter by 1¾ inches long over all, and were made as follows: The bar was cut into pieces 1⅞ inches long, faced off perfectly flat on the bottom end, the other end slightly raised toward the center and highly polished, after which it was ready for the impression.

The "hub" is made very shallow, engraved by hand and carefully hardened, after which it is sunk into the die the full depth. This was formerly done in the drop hammer, but it never proved entirely satisfactory, because of the inability, when striking several blows, of keeping the bottom of the impression perfectly flat. It was finally done in the same press as the embossing, and done cold, usually in three blows, and always turned out successfully.

After the full impression was made the die was carefully chucked in a special device made for all oval styles, and turned back on both sides of the face to a shoulder ¼ inch deep, as Fig. 5, locating the impression exactly in the center; after which the die was rechucked in an independent jaw chuck and the face or bottom of the impression set perfectly square and central, regardless of the wall of the die. The die was then faced off to leave the impression the proper depth and the wall

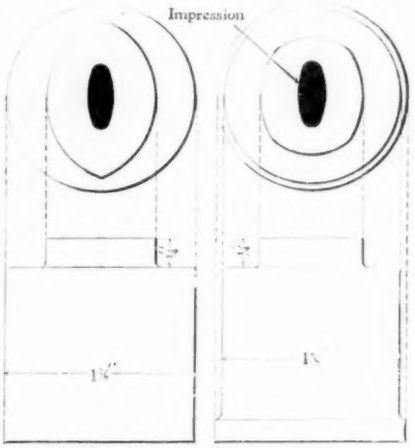


FIG. 5 FIG. 6

EMBOSSING PLUG OF DIE.

was turned to size very carefully, after which the two high points of the oval on the face were turned back to the shoulder, which left a raised "tit" similar in shape to Fig. 6, when the die was practically ready to be "scalloped," which "scalloping" was worked back to the shoulder perfectly straight, leaving a small fillet at the shoulder, sized with a templet, Fig. 7, and the edges of the face slightly rounded so that the medallion when finished had what we called a "raised" edge.

The end of the die previously held in

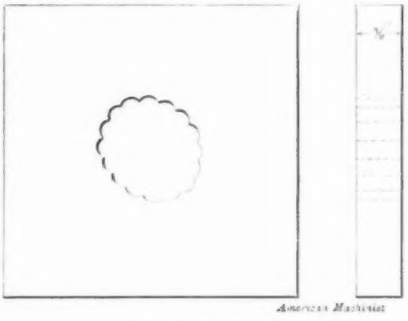


FIG. 7. TEMPLET.

the chuck was then turned to size and length in a special "boss" chuck.

A groove was then milled in the wall central and straight with the figure, and a piece fitted to same for embossing the ear or lug, and fastened with a screw and

dowel pin (see Fig. 8). This was not a particular job.

It may appear peculiar to a great many toolmakers that the die was not made with the ear all in one piece. As a matter of fact, the very first dies were made in one

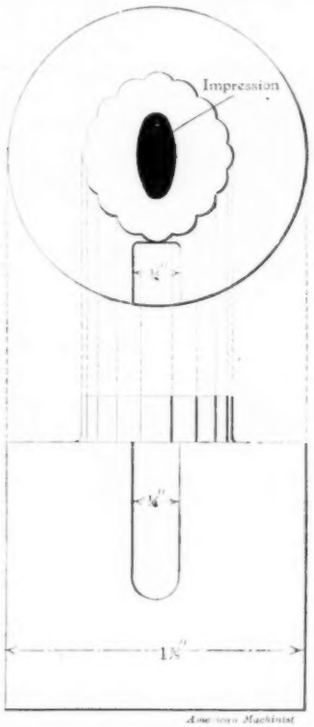


FIG. 8. DIE WITH GROOVE FOR LUG.

piece, but they proved anything but satisfactory, as the ear in hardening had a tendency to split away from the body, which necessitated the annealing of the die to patch it.

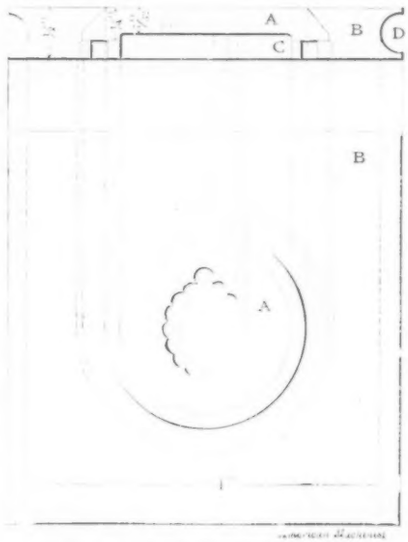


FIG. 9. PLATE AND SIZING RING.

The screw and dowel-pin holes for the lug were carefully plugged with fire-clay and the die was hardened. The water was burnt off and it was left to cool slowly. The die was then highly polished on all the raised parts with what was called "diamond dust" and a cork, and the base ground flat and parallel with the face, after which it was ready to put into the press.

The dies were held in the bolsters by special clamps with two screws through the lugs of the clamps always insuring the base of each die being perfectly flat against the hardened steel center, Fig. 4.

A hardened-steel sizing ring *A*, Fig. 9, which prevents the metal from expanding beyond a certain limit, was fastened in another steel ring or plate *B*, also hardened and ground, with a screw collar *C*, not hardened, with two holes for a pin wrench. Plate *B* had two grooves *D* on opposite ends into which the stripping lugs (not shown) were placed, which, after the blank has been embossed and the press is on the return stroke, push the sizing ring down to the shoulder, and a little below the face of the lower die, as in Fig. 10, and enable the discharge of the embossed blank. In our case this was rigged up in connection with a blower, so that the valve opened at the right time and a sharp puff of air blew the blank away down a chute and into a box.

The feeding of the blanks to the die was done with a slide actuated by the movement of the press, and all the opera-

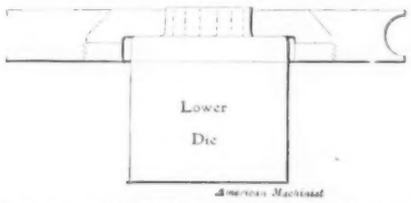


FIG. 10. SIZING RING DOWN ON SHOULDER.

tor had to do was to keep the hopper filled with blanks and see that the ear was in the right position, as the slide, on the completion of the backward movement, picked up only one blank at a time and carried it forward into the sizing ring, which, except in stripping, was always level with the bracket on which the slide moved, and the hole in the slide, when the press was at rest, would be right over the sizing ring or die, and on the commencement of the press movement would travel backward out of the way and pick up a blank, as detailed above. A. C. R.

Regulating Atmospheric Temperature and Humidity.

Editor American Machinist:

That was quite an interesting account which you gave at page 293 of the arrangements at the new building of the National Bureau of Standards for regulating the temperature of the air in the rooms and also for adjusting the humidity of it according to requirements. This is an object lesson which may be studied with profit by mechanics and engineers and by all who make a business of breathing and working. The example set in the above case seems to be more deserving of study than usual, as the work is done more completely and with a fuller recognition of the different conditions to be complied with.

The acceptance of the fact that there is something more to be done than merely the heating of the air when it is too cool is in itself an example for the majority who have generally ignored it. No provision has been made, except in rarely exceptional cases, for any control or modification of the atmospheric conditions in our houses, offices and factories beyond the devices for heating the air in the winter, and in these we have distinctly retrograded, so far as their healthful operation is concerned. Nothing, I suppose, is more fully understood in theory and more completely ignored in practice than the necessity of constantly renewing the air wherever breathing apparatus are in operation. The means generally employed for heating up to, say, fifty years ago all carried with them a continual changing of the air or a drawing in of fresh air as an unavoidable result of their operation. The open grate or the stove could operate only by the production of a constant current of vitiated air up the chimney and a constant inflow of purer air from the outside. The later heating arrangements did not involve this renewal of the air. The hot-air furnace of course did to some extent, but the air which it circulated was vitiated and de-vitalized by its contact with hot iron plates and by the leakage of furnace gases, and the later steam pipe arrangements for heating involved no change of air wherever they were used. In the old shops, even when steam heated, the air would generally manage to find many crevices both for ingress and exit, and the air would not usually get very bad; but the modern shops are more nearly air tight, and the air consequently has much less chance of change and purification, and the men suffer in consequence, although generally with entire unconsciousness of the cause. The renewal and circulation of the air is of course as necessary to be planned for as the heating of it, and becomes more imperative as the buildings become in other respects more perfect. This vitiated and unrenewed air effect is perhaps at its worst in some of the modern office buildings. These are practically all steam heated and air tight, and the revolving door at the entrance is always on guard against the fresh air when the steam heating pipes are working.

Now, I am an ardent admirer of the modern—sha'n't we say American?—office building. It provides much more comfortable quarters and greater facilities in many ways for the easy and rapid transaction of business than were ever enjoyed before. It is so good that it ought to be better, and especially in guaranteeing precise atmospheric conditions, and this not merely in the winter months but for every day in the year.

Those who pay any attention to the heating of shops in the winter at least

know how bad it is to let the temperature get too high. If it gets up to, say, 80 degrees the work is bound to suffer. The men get lazy and listless, and through no fault of their own less work is turned out with more discomfort. When this effect is discovered of course we shut off the steam, and perhaps open the windows or take other means of reducing the temperature to a more workable level. Now, why should it not be possible to control the summer temperatures when they get too high? Of course it is now possible enough, but the question still remains whether it will not cost more than it comes to. This we may expect will some day be settled in favor of complete atmospheric control. In our winter heating experiences it is generally found that in different departments of the works different temperatures are desirable, the pattern shop, for instance, naturally requiring a temperature considerably higher than the blacksmith shop, where more violent physical exertion is the habit. Why not take the pains to secure to each just what is best for it?

Besides the reduction of the air temperatures when too high, the humidity perhaps requires still more correction for a large portion of the year, and especially near the seaboard. Much discomfort and inefficiency and many actual temporary breakdowns of the human system result from the summer conditions which have hitherto been considered beyond human control. Happily, the hitherto unthought of is now becoming possible and practicable. The same apparatus for atmospheric control is largely available for both summer and winter conditions, at least the circulatory part of the apparatus and the rest of it need not be costly. If it is too early in the day to be getting things down as fine as this for the shop, it certainly is not so for, say, laboratories and hospitals to begin with, and then we can look for a rapid extension of the conditions of health, comfort and efficiency to hotels and houses of the better class, and after them the luxury of precise atmospheric conditions all the year round, once established as a standard, may be expected to be continually more widely extended. It certainly is high time, now that the means are all provided, to begin to insist upon getting our air to breathe as pure and as nearly the correct temperature as we expect to get the water we drink.

TECUMSEH SWIFT.

Burning on a Casting.

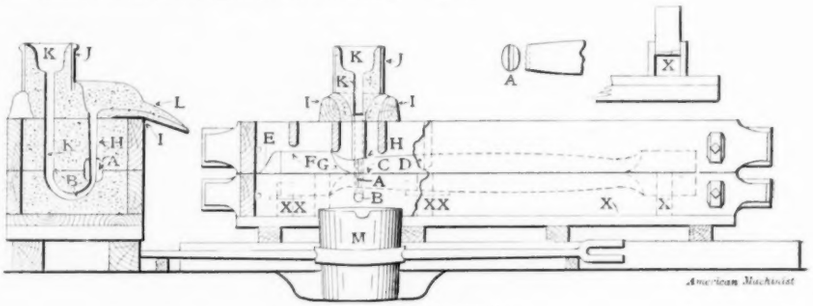
Editor American Machinist:

I was interested in Mr. Tecumseh Swift's letter at page 413, about "Carving Sand." He suggests that we in the foundry might do many things in the way of casting without patterns in special cases by the exercise of a little ingenuity. Much in the sand-carving line is already done in the founrry. We often give a pattern to a molder and find that when it is drawn from the mold the molder has to build up and mend and then must be a good carver to form the mold to its proper shape, carrying the lines and curves in his head with considerable accuracy in order to produce a satisfactory casting. In the case of the rod which Mr. Swift had to do with, I would suggest that it might have been "burned" together, and I will describe the process.

We take the two pieces of the rod and in the end of each piece we cut a groove as shown at *a*, Fig. 1.; so that when the two broken ends are butted together we have a hole running through the rod some ¼ inch across. If we had plenty of time I should have the flask taken to the carpenter shop and with it the plain mold board, and have four rests *x x* for the rod put on the board. If short on time, I should have four pieces sawed off, say, 3 and 3¼ inches high, and tacked on to the board. Two pieces of 4x4 or 5 inches are laid on the floor and leveled to raise the flask. The board is next placed on them, the cleats on the board crossing the 4x4-inch. The broken casting is laid on the rests, the break is butted together, wedges being pushed under the casting on the rests, thus bringing them in line, the board beveled across each end. A straight-edge is used on the side and the top of the broken casting to true it in position. A little cotton waste is put in the hole in the casting to keep out the sand. The nowel or drag is laid on and the sand is carefully rammed around the casting, not very hard, where the break is. When done, try with the straight-edge. Scratch out the sand under where the break is and remove the waste underneath. Place the horn sprue *B* in position and make a parting to lines *E F G* back to *D*. Put on the cope, remove the waste on top, put in gate-stick *H*, also gate-stick *K*, having it come down on to the horn sprue *B*. Ram up and remove the cope (cope rammed back to the dotted bar *D*). Draw out the gate-sticks, slightly chamfer off the edge next to the casting, remove the horn gate and, with blowers, blow through the horn sprue or gate, so that it is clear and clean through the gate and up through the hole in the casting. Replace the gatesticks in the cope, but leave them up an inch, and tuck the sand around them at the top of the cope so that they will not slide down. Put on the cope.

Take a piece of sheet iron and claywash it after bending it to form spout *I*. Place pig iron with the ends resting on the sheet iron across the flask with short piece between at the back and build in sand to form a flow-off, so that the iron will run down spout *I* into the ladle, the sand being held to the sheet iron by claywash. I have used a ring of cast iron *J* above the pig iron for a runner box with a basin formed at the top of pouring gate *K*. Cut around the pouring gate *K* and blow out the runner clean; also around the flow-off *H*. Remove the gatesticks and weight the cope or use clamps.

Have the above near the cupola. When ready to pour, let enough men with single-hand ladles keep a stream of iron *while hot* going down the pouring sprue or gate *K*. Be sure and have it skimmed clean and have the first ladle white hot and the rest the same. When the ladle *M* is full, remove it and replace with another. You can stop pouring long enough at this stage. If there is any doubt or delay while the ladle is out, pour in a little. Bring up the other ladle, throw some sand over the iron in the bottom of the pit, and set the ladle on it.



"BURNING" A CASTING.

The reason for having the basin to pour into at the top of the pouring gate *K* being so much higher than the top of gate *H*, up which the iron flows off into ladle *M*, is that the iron shall flow quickly and freely. If there is any stagnation at the start, good-by job. Have the basin you pour into high enough above the flow-off so that the iron will be forced through quickly. In most cases where a failure has been made in a burning job, unless the iron was too dull, I have found that the pouring basin was not high enough above the overflow. In a job of the above kind I prefer a flat gate rather than a round, the flat part running lengthways of the casting or across the break, but remember that the overflow must be in proportion to the inlet.

A gentleman came to a foundry which I formerly had charge of with a broken crank. It was a double crank standing quartering. Could I do anything for him? Yes, burn it! One end was broken off some 4 inches in. We burned it. In some three weeks he was back again; it was broken in another place, and we burned that. I have seen a lot of burning jobs,

but I never knew of a job properly burned to break where burned or very near it.

Regarding the iron running into ladle *M*, we carry it off and pour other work; so when the job is burned we have not lost to exceed 75 to 100 pounds to pour it.

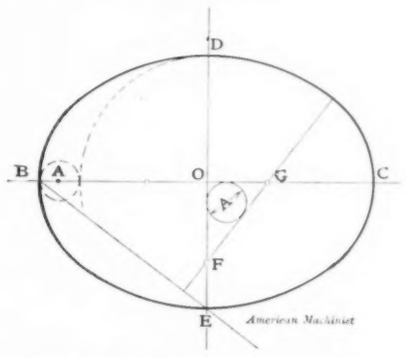
R. H. PALMER.

The Approximate Ellipse.

Editor American Machinist:

The article by T. V. Powers, at page 385, giving a method of constructing an approximate ellipse, calls to mind a method I have used for several years, which, within certain limits, gives a close approximation to the ellipse. While this may not be new, it may interest some of your readers.

Referring to the enclosed sketch, *D E* is the minor and *B C* the major axis. Taking the difference between *O D* and



CONSTRUCTION OF THE APPROXIMATE ELLIPSE.

O B as the diameter of the circle *A*, draw *A* tangent to *O E* and *O C*. Draw *B E* and erect a perpendicular cutting *O E* and *O C* at points *F* and *G* and tangent to the circle *A*. The points *F* and *G* are the centers from which the circular arcs are drawn with the radii *F D* and *G C*.

F. L. WHITE.

Monthly Meeting of the A. S. M. E.—Pich Process of Brazing Cast Iron.

Owing, probably, to the exceedingly stormy weather, the attendance at the regular monthly meeting of the American Society of Mechanical Engineers, held on Tuesday, April 7, at the society house, 12 West Thirty-first street, New York, was somewhat smaller than usual. There was, however, considerable interest displayed in the paper of the evening—"The Pich Process for Brazing Cast Iron"; in further information given by Mr. J. S. L. Alexander, of the American Brazing Company, of Philadelphia, which company controls the process in this country; and in the actual operation of brazing by this process, apparatus having been specially fitted up for the purpose, by means of which a couple of broken cast-iron specimens were brazed, after the discussion which followed the reading of the paper.

Neither President Dodge nor the author of the paper, Mr. Wilfred Lewis, was present, Secretary Hutton presiding and also reading the paper. This process, as stated in the paper, is the invention of a German, named Pich, and has attracted much more attention in European countries than here; Krupp, among others, having used it in putting together very large castings. The author, according to his paper, first became interested in the process through seeing it used in repairing a large pump cylinder in Philadelphia; and he mentioned in the paper several other interesting examples of machine parts repaired by this process. The preparation used is known as Ferrofix, of which, as our readers will remember, we have made mention at several different times in our columns. This is a dark brown powder, and is really a metallic oxide, the action of which during the heating of the metal is to burn out the carbon in the vicinity of the joint. This powder is mixed with a liquid, and in the form of a paste is applied to the ends to be joined, these having been of course thoroughly cleaned. The parts are then brought together, the paste acting, in a way, as a cement to hold them in place; they are placed on suitable supports and the gas or other flame is applied as in ordinary brazing. The metal being brought to a temperature of about 1800 degrees Fahr., a flux—either powdered borax or some similar material—is applied, and then the spelter is put on. The brass used may be hard or soft, according to the material to be brazed. When properly applied this covers the ends of the parts thoroughly, and a positive and smooth joint is the result. The spelter evidently penetrates the iron for some little distance, as traces of it have been detected (under a powerful glass) fully 3 inches from the joint. Some castings repaired by this process are chipped at the end to form new surfaces before applying the Ferrofix. In other cases where small parts are broken out, these parts may be replaced and brazed in their original positions. In Europe it seems many complicated castings have been made in sections and then brazed together, there being less liability of flaws in such castings and the completed work being stronger than if cast in one piece. Where a casting is cracked the preparation may be squirted in from an oil can, the work then being heated and brazed. Gears having one or more teeth broken out may be readily repaired, the teeth being put back and brazed in place. Mr. Alexander mentioned a number of interesting applications of the process, such as filling in blow holes in castings—by coating the cavity with Ferrofix, putting in spelter and then pouring in molten iron; brazing steel plates, large and small, to castings spongy or cracked; and brazing large machine beds which had cracked in service. A number of small cast-iron blocks which had been brazed were exhibited, and also a photograph showing a heavy shear which had cracked in a peculiar manner and which had been repaired by this process. He gave the cost of the preparation as being less than ½ cent per square inch of brazed surface. Cast-iron specimens tested before and after the brazing operation, it was stated, were increased in tensile strength from 5 to 10 per cent.; the action of the preparation in removing carbon really converting the metal near the joint into a low grade of steel.

Metallurgical Section of the American Foundrymen's Association.

An interesting paper setting forth the functions and prospects of the above has been prepared by Mr. Herbert E. Field. The new section of the association is designed to act as a central exchange for ideas and to direct the advancement of metallurgy in its relation to foundry and furnace practice. It proposes to systematize and unify chemical practice which is of such growing importance in foundry operations. It will prevent much of the labor now lost in the numerous duplication of similar experiments, and will provide that investigations shall be carried on under the most auspicious circumstances. It will standardize methods and will point out those which are inaccurate.

"This section is organized for any who are engaged in the study or practice of chemistry and metallurgy of iron. There is no intention of taking the place of or interfering with the work of any other society. This is a time of specialists. We are, it is true, interested in the work of our fellow scientists in all other lines of work and would be the last to lessen in any way the great good being accomplished by our national scientific societies. There is, however, a crying need in the iron business for an association active, alive and awake to the conditions and opportunities of the times. An association before which papers may be read? Yes! But an association which will help and educate its members in the metallurgical side of the iron business, an association which, proceeding in a thorough and systematic manner, will investigate and solve problems arising in everyday practice of metallurgy in foundry and furnace work. It is just this place that the metallurgical section is designed to fill, and will fill with credit to itself and to the American Foundrymen's Association, provided it is given the proper support.

"The essential factors for a successful organization are all present—an opportune time, an unoccupied field, an increasing demand and a strong parent organization. The scope and usefulness of the Metallurgical Section of the American Foundrymen's Association will only be limited by the number and activity of its members."

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The Inventor and the Man.

Those who have read any of the engineering reminiscences of Mr. Chas. T. Porter which are appearing in our columns will need no urging to continue their reading of them, as each installment pays liberally for its own perusal and whets the appetite for more. The portion of the narrative which appears in our present issue, however, seems to demand special notice, by reason of the remarkable series of events related. It is as simple and straightforward and unpretentious as it is possible to imagine, but it tells of one of the most wonderful achievements within our knowledge. There are those, perhaps, who will see in it only the triumph of the engineer in conceiving and perfecting and installing with complete success the high-speed engine; but to us it is the success and triumph of the man more than of the engineer, and for this reason it is of as deep interest to one who is without the slightest technical knowledge as to those most deeply engaged in mechanics and engineering. Invention and mechanical precision, although here of their highest forms, are in this instance overshadowed by perseverance and pluck. The invention and the ability to construct might have been all there, and yet in the hands of some other inventors, perhaps as great, the business obstacles that were to be overcome might have indefinitely postponed the development of the high-speed engine. The narrative is another enforcement of the lesson that the successful inventor must be something more, and indeed much more, than an inventor merely.

Trusts and Patents.

William Stanley has written a letter to the *Springfield* (Mass.) *Republican*, in which letter he gives some of the methods of the trusts in handling patents, and we quote from it as follows:

"The industrial trusts now regularly employ, on salary or by retainers, bureaus known as boards of patent control. To these boards is intrusted the problem of controlling the arts, by means of patents. They are expected to purchase such patents as they deem expedient, to manufacture any others they think necessary, to gather up 'fresh lines of patents' wherewith to assail competitors, to bring suits against infringers, real or imaginary, and generally to operate an offensive patent campaign against competition.

"No more pernicious system of controlling trade has ever been devised, and none that is in reality as fatal to the value of honest patents, whether they be owned by the trusts or their competitors. To speak plainly, these patent bureaus pursue an organized effort to obtain illegal support from the United States courts. They, too, often endeavor to restrict trade by means of dishonest patents, obtained in various ways from the Patent Office, for the specific purpose of controlling an art long disclosed to the public, and consequently free.

"The trust patent bureaus are occupied in litigation directed against their competitors. They endeavor to weaken competition by exhausting the resources of their opponents in costly legal proceedings, prosecutions brought under questionable patents, and sustained by expert witnesses, who are simply the salaried testifiers of the trusts. . . .

"A few years ago an important advance was made in a well-known art. The invention employed new and specialized machinery and the application of newly discovered data and facts. Shortly after the inventor had successfully completed his working system he demonstrated it before a number of trust officials, plainly describing its operation and pointing out its far-reaching possibilities. The trust proceeded as follows: First their attorneys drew up a patent specification, cleverly disguised as a 'blanket patent,' to cover the art on broad lines, and then sent it by special messenger to Europe to find an inventor to sign it. After a little preliminary work the messenger returned with the document duly executed. The papers were then delivered to a second trusted attorney, who was instructed 'to get it through the Patent Office.' The Patent Office was presumably honest, but of course ignorant of the true condition, and in a very short time granted the patent.

"Here, then, was a patent that cost the trust a few thousand dollars, signed, sealed and delivered, upon which the trust proceeded to issue new stock to the amount of several million dollars, a patent that on its face was genuine, but in reality was the grossest fraud.

"To keep the real inventor from making trouble the trust allowed him a small pittance, kept its spies about him, copied his private papers, bribed his servants, spoke of him as untrustworthy, irresponsible, and generally cast stones at him. But in this case justice to the public, at least, was done. The United States Circuit Court on the first hearing brought under the fraudulent patent disqualified it, although in entire ignorance of its real history.

"We may well consider whether this was an attempt to restrain trade, and whether such attempts are likely to stimulate invention by holding out suitable rewards to inventors.

"One more example will illustrate a less heroic and more common trust trick. The *United States Patent Gazette* suddenly discloses the issue of a patent covering an important invention in an art. The trust attorneys see it, obtain copies of the patent from Washington, and decide to have it. The inventor is looked up and an offer to purchase his invention is made, coupled with some statement to the effect that one of the trust's inventors had worked out the same result some years before. Now, unless the inventor sells the patent then and there, he may be subjected to the following coercion: First, notice is served on him by the United States Patent Office

that (although this patent was issued to him) an interference had been declared between his patent and a new application. Testimony is then taken as to the dates of invention claimed by both parties. In all probability the real inventor proves his priority, and the contending application is dismissed; but—and here the important part comes in—the trust lawyers are now in possession of the inventor's sworn dates of invention, back of which he cannot go. Another application signed by another applicant is put into interference with him. Again the dates of invention are given, and the inventor now realizes that he has a hard fight for his patent on his hands. Testimony is taken (the trust does not appear in the matter, of course), and the interference drags along, sometimes for years. Occasionally the inventor is visited by the trust representatives, and suggestions that he sell out are given him in a roundabout way. In 99 out of 100 cases he sells for a trifle and finds himself impoverished and unknown. . . ."

Mr. Stanley proposes as remedies for such conditions the limitation of patents to those which clearly disclose invention and refusing patents for so-called tributary or subsidiary improvements; the employment of expert witnesses by the courts and having them give their testimony in the court, acting rather as advisers to the court than as employees of litigants, and the strict enforcement of the laws applicable to conspiracy to injure an individual or a business by unnecessary litigation, together with such modification of the laws as will cover the coercion methods employed.

The fact is, however, that unfair and dishonest methods of dealing with inventors were used long enough before trusts were invented, though of course trusts have naturally perfected these methods in some cases.

An inventor once appeared in the office of a large sewing-machine factory with an invention which he offered for sale. During the conversation with him the company's expert was called in to view the model, and it was understood that the invention, though in crude form, was important and that it could not properly be ignored. Did this concern, with an abundance of money, offer to pay a fair price for this invention? By no means. It adopted an entirely different course. The inventor was requested to call again in two or three days and informed that, in the meantime, the matter would be looked into. He called according to the appointment. The intervening time had been used in the hasty making of a model embodying his invention. This model was then covered with oil, dust sifted over it and various other things done to it to give it the appearance of age, and when the inventor returned this model was brought out and shown to him with the declaration that it had been made in the experimental department of this factory years before. By that means the inventor was defrauded of nearly, if not quite all, the returns he was fairly entitled to for his invention.

In another large factory it was the custom to show inventors with models into a certain room in the middle of which was a table. At a certain point in this room was an opening in the wall through which the lens of a camera could be made to point and the opening was so disguised as to be unnoticeable. The proprietor, who posed as a great inventor, would place the model before him on the table, turn it one way and another as he talked with the inventor about it, and in each new position in which he placed it an accomplice in the next room photographed it. If then it were thought worth while, these photographs, or a model made from them, would be shown the inventor on his next visit, to convince him that his idea was old.

Both these tricks were regularly practiced long before trusts were invented, and they go to show that rascality is not the invention of the trusts and that they by no means monopolize it. It goes without saying that men who will do such tricks as these are no better than ordinary thieves, if as good, no matter how much money they may have nor what may be their standing in the communities in which they live. Highway robbery or piracy is an innocent and respectable business compared with such practices, and it is to be hoped that either by the means proposed by Mr. Stanley or some other they may be broken up. Trusts may carry them further, but they did not invent them, and a dishonest man is no more dishonest because he may be a trust official.

Weights and Volumes of Metals in Alloys.

The differences in the specific gravities of metals lead to some rather mistaken impressions as to the proportions of different metals in alloys, the ratios by volume being so different from those by weight. This may be illustrated by an extreme case. The specific gravity of gold is 19.26, while that of aluminum is 2.67, or the one is 7.2135 times that of the other. If we could have an alloy consisting of 90 parts, by weight, of gold and 10 parts of aluminum, the quantities by volume would be 55.51 and 44.49, respectively. If we had 87.83 parts of gold, by weight, and 12.17 parts of aluminum the volumes of the two metals would be equal. With 90 parts of aluminum, by weight, and 10 parts of gold the relative volumes of the metals would be 98.48 and 1.52. Using the other metals, silver, copper, etc., in alloys with gold the differences would be in the same direction, but not of course as large. In our gold jewelry we have always less in bulk of the precious metal than we think of when we think of the weight alone, while in the common alloys of aluminum there is much more aluminum in volume than the statement of weights suggests.

Free Expert Engineering by the Russian Method.

Some months ago the daily and trade papers had much to say in regard to the securing, by Mr. M. A. Verner, Pittsburgh, Pa., of the contract to design and construct an electric railway system for St. Petersburg. Recent reports are to the effect that after Mr. Verner's plans had been accepted and he had been awarded the contract for the construction of the system, he was turned down, without any prospect of remuneration for time and expenses amounting to many thousands of dollars.

This transaction brings to mind the experience of Mr. Frank E. Kirby, Detroit, Mich., as published in the AMERICAN MACHINIST at page 122, Vol. 24, from which it would appear that after Mr. Kirby had, at the solicitation of the Russian Government, prepared plans for an ice-breaking steamboat to be used in ferrying the Siberian Railroad trains across Lake Baikal, and appeared in person at St. Petersburg to explain same, he was frozen out and his plans turned over to an English company, which was awarded the contract for building the "ice-breaker" without compensating him for his plans and expenses.

Under the circumstances we should be pardoned if a suspicion should enter our minds that Mr. Verner is the victim of another scheme on the part of Russian officials to procure, free of cost, valuable engineering data. We can get some satisfaction, however, in the belief that Russia does not make anything by her short-sighted policy. The "ice-breaker" has not been the grand success that was expected or that has been represented in numerous glowing accounts.

I was in the Lake Baikal regions for the greater part of 1900 and 1901, and crossed the lake several times. The ice-breaker was first in service in the spring of 1900. I made my first trip across soon after it was put in commission. At this time I also saw a smaller reserve boat in course of construction; it was launched a few months later. The "ice-breaker" brought to my mind the similar boats in operation on our own Great Lakes, and when I learned that it was built by an English company it occurred to me to wonder when and where they got the necessary experience to design boats of that class. The explanation came the next spring upon the arrival of the copy of the AMERICAN MACHINIST above referred to.

From my observation of English nature I cannot conceive that they could take a set of American plans and build a boat to them without alteration—they would see too many places for improvement (?). Changes made merely on the basis of prejudice and conceit, without ice-breaker experience, would be certain to lead to trouble.

I was informed by one of the officials of the boat that it was guaranteed to make its way through ice 4 feet thick, and that although the ice on the lake froze to the thickness of 6 feet it was expected the

boat would be able, by following the same channel, to make its trips throughout the winter without interruption.

That (the first) fall the "ice-breaker" and its auxiliary were both put out of business in November, before the ice was a month old, and did not make any trips until late the next spring. The ice does not go out until about June 1 and throughout the long winter the 40-mile trip across the lake had to be made over the ice in sleds. The second winter, ditto. I have not received positive information in regard to third (present) winter, but I believe they are using the sled transportation as usual to fill this gap made by Lake Baikal in the Siberian railway line.

It remains to be seen what the Russian officials will do with Mr. Verner's plans, and whether, in case they attempt to use them, their efforts will be crowned with success.

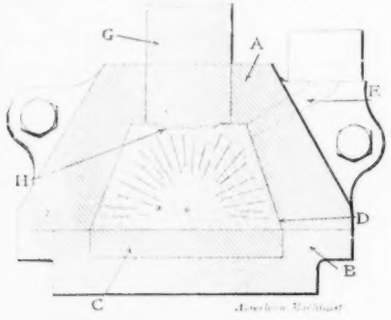
If the suspicions aroused by the reports herein referred to should prove to be well grounded, the alarm should be sounded so that our engineers may be on their guard and not allow themselves to be tempted to donate valuable time and hard-earned cash and experience to the charitable purpose of supplying Russia with gratuitous engineering service. From my own knowledge of the Russians and their methods I should hesitate to put data of any value in their hands unless they would first put up the requisite cash in this country. If they should comply with this demand, I would not care to enter Russia to discuss the subject without a suitable guarantee against trumped-up charges and detention, as they could easily make one feel glad to refund advanced payments for the privilege of being allowed to depart from the country. CHAS. W. BARNABY.

New York City.

Some New Things.

CASTING STEEL EMBOSSING DIES.

A patent has recently been granted for making embossing dies by the method shown, which consists briefly of a metallic

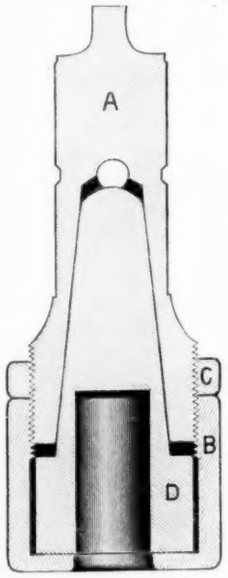


MAKING STEEL EMBOSSING DIES.

mold which is made in sections as shown. The portion *C* is of a non-conducting material, and after the melted steel has been poured in at *I*, a plunger, which the inventors call a "patrix," is pressed down through the opening at the top. This patrix is made of bronze, and on its face is an impression corresponding to the work to be produced in the die. The high heat-conductivity of the bronze results in the face of the die being quickly chilled, while at the same time it prevents the bronze from being melted, and as this patent has been issued to men who reside in the heart of the jewelry industry, we presume it has been tried and found to work successfully.

FRICTION TAPPING DEVICE.

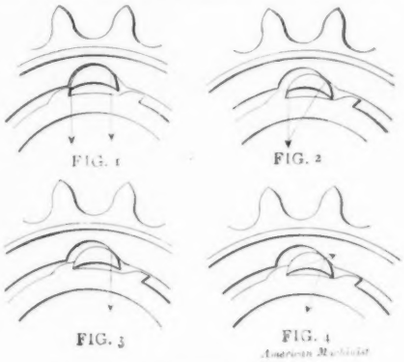
In this device the tap is held in socket *D* by two steel keys (not shown). The socket or holder has a taper shank extending into the body *A* and is held in place by cap *B*. Sufficient friction is created by fiber washers, placed between the body and holder, to drive the tap; but if the tap strikes the bottom of the hole before the spindle is reversed, the holder is allowed to slip and so prevent the tap from breaking. The friction necessary for driving different sizes of taps is obtained by adjusting cap *B*, a locking nut *C* holding this in place after it is properly adjusted. This device is made by the Whitney Manufacturing Company, of Hartford, Conn., and is designed to fit their "Presto" drill chuck.



FRICTION TAPPING DEVICE.

IMPROVED RATCHET AND PAWL.

The cuts herewith are reproduced from *The English Mechanic* and illustrate a new device of the coaster brake type called "the micrometer free wheel." It is said to have had a prolonged test and to owe its success to the fact that its action is entirely automatic and that no springs are required. Fig. 1 shows the extreme point of the tooth engaging with the pawl, which position evidently cannot be maintained, as the driving action puts a twofold pressure on the pawl, as indicated by the lines and it slides into the full driving position as in Fig. 4. In Fig. 2, which shows the first movement, one end of the pawl has gone down first while the other end is still engaged with the driving face of the tooth. In Fig. 3 the other end of the pawl has gone down to the bottom of the tooth, and it is always brought to this position in the act of driving, while a little further advance brings the pawl to the completed driving position of Fig. 4. The



IMPROVED RATCHET MOVEMENT.

easy angle which contacts with the pawl on the reversal of the motion of the inner wheel immediately lifts the pawl free. This device is made by the Micrometer Engineering Company, Coventry, England.

Technical Publications.

"Kinematics of Machines." By R. J. Durley. 379 6x9-inch pages fully illustrated. John Wiley & Sons, New York; Chapman & Hall, London. Price, $4.00.

Professor Reuleaux has apparently determined for all time the fundamental methods, or, at any rate, the fundamental conceptions of kinematic analysis. The present book is based on Reuleaux's methods, but in some directions extends the analysis materially beyond what was done by Reuleaux. The analysis is essentially graphical, but some mathematics is nevertheless found necessary. The book will be found to be of decided interest to all students of mechanism as a science.

"Elements of Steam Engineering." By H. W. Spangler, A. M. Greene and S. M. Marshall. 275 6x9-inch pages, with 273 illustrations. John Wiley & Sons, New York. Price, $3.

This is a descriptive text book intended for first-year engineering students, its object being to familiarize them with the various elements of steam plants. Some portions are exceedingly elementary, and bring to mind the limitations of high-school boys as engineering students. It does seem a little incongruous that it should be necessary to include in a university course of instruction descriptions of monkey wrenches and pipe fittings, although the book as a whole contains much that few students from any walk of life could have acquired by observation. As a preliminary outline of the machinery which naturally receives a large amount of detailed analysis during the later years of a college course, the book should serve a very useful purpose.

Personal.

Axel Hansen Möller, a merchant of Copenhagen, Denmark, is now in this country for the purpose of establishing agencies in Scandinavia for hardware, tools and agricultural machinery. He is stopping at 726 East 138th street, New York.

J. L. Barnes, who was formerly in New York, but for three years past has been at the head of the tool drafting department of the Western Electric Company in Chicago, has returned and will be in the New York factory of the above named company.

Arthur Ernest Sims, an Englishman, who has been working as a machinist for the Almy Water Tube Boiler Company, Providence, R. I., has developed phenomenal talent as a landscape painter, and has finally left the shop for the studio, which already assures him a living income, his pictures being in constant demand, with the promise of a brilliant future in his chosen profession.

Obituary.

S. Morgan Smith, president of the S. Morgan Smith Company, York, Pa., manufacturers of water wheels, died at Los Angeles, Cal., April 12, sixty-five years old.

Katherine K. Taus died at Wilmington, Del., April 10, one hundred years old. Her husband, who died in 1827, was one of the earliest builders of steam engines in Philadelphia.

George Johnson, a manufacturer of cold-rolled steel, died at West Catasauqua, Pa., April 7, fifty years old. His father was a steel manufacturer in Sheffield, England, and came to this country and established a steel plant in 1861, the son succeeding him in 1881.

William Warren Card, second vice-president of the Westinghouse Air Brake Company and president of the Pittsburg Screw & Bolt Company, was killed by a trolley car April 4. Mr. Card was born in Madison County, N. Y., in 1831, the son of a civil engineer, to which profession he also was educated. He went West and became a builder of railroads and then a superintendent. The Westinghouse air brake was first tried and was completely successful upon Mr. Card's division from Pittsburg to Steubenville, of the Panhandle road, and Mr. Card became at once an enthusiastic advocate of it. He became a sales agent for the air brake in 1872, and was made secretary of the company in 1879, retiring from active service last year as vice-president. Mr. Card was a millionaire with many business interests, and four years ago he became president of the Pittsburg Bolt & Nut Company. He had been an active member of the American Society of Civil Engineers since 1883.

Commercial Review.

NEW YORK, Monday, April 13, 1903.

Trade in the machinery market during the past week was rather quiet, in consequence of the Easter holidays. Machinery men, however, express the greatest satisfaction with the situation, and remain as optimistic as ever concerning the outlook. The spring season is giving a good account of itself, and much business known to have been in sight months ago, is gradually taking the form of orders. Builders of special machinery report things in their line to be more satisfactory than they have been in months.

Manufacturers of machinery are evincing more interest in the pig-iron situation than they have in months. The recent reduction in Southern irons for the latter half of the year has caused considerable speculation to be indulged in as to what the ultimate outcome of it will be.

It is a little over a week ago since the reduction was announced, yet all reports agree that prices of iron, both for Northern and Southern brands, and for immediate and forward shipments, have receded, some maintaining that the decline has been as much as $1 per ton, with recessions in foreign irons correspondingly as large.

While exception may be taken to the truth of these statements, no risk whatever is taken in asserting that the pig-iron market is now in an unsettled condition, and buyers are refusing to make contracts for such iron as they think they will need for the balance of the year, believing that lower prices are yet destined to prevail. This belief exists so firmly, that sellers of pig iron report buying at present to be confined almost entirely to meeting immediate current requirements.

Recent developments along the lines we have mentioned show the great wisdom that has been displayed by manufacturers of machinery during the past year, and especially during the past six months, in the matter of prices. The period in question was notable for the upward tendency in price of pig iron, coke, freights, and labor; in fact everything that entered into the manufacture of machinery. Time and time again the temptation to raise prices was strong, in fact seemed compulsory on the score of self-protection. Yet outside of a 10 per cent. advance in machine tools last June, followed immediately by a similar advance in all kinds of machinery, prices have remained unchanged, although in the interim, as we have already intimated, additional advances would not have evoked much if any adverse comment, from those who took the trouble to inquire into the why and wherefore of the matter.

Had such a course been pursued, manufacturers of machinery would have found it difficult to adjust their prices to meet the present situation. Buyers would come to them and tell them they had taken advantage of a rising market to boost their prices, and now that the market has suffered some recessions, they ought to give their customers the benefit of it. As it is, making due allowance for all that has recently happened, and what is likely to happen, the manufacturers deserve the highest praise for the generous policy they have pursued, and buyers should feel grateful toward them for it.

Prices of machinery to-day have undergone no change recently, and the best opinion is they will not. Giving the believers in or advocates of lower prices everything that they may claim should come as a result of what has transpired, or will probably transpire, in pig iron, they must not overlook the fact that no reduction has taken place in the price of fuel, none in labor, and none in freights, nor is there the slightest reason for beliving *now*, that any reductions in the things we have enumerated, are imminent. This is something which should not be overlooked, particularly when the market for pig iron is likely to have a drooping tendency for the balance of the year.

Three weeks ago, in commenting on the movement to establish a municipal lighting plant in the city of New York, we stated that the trade should not take the proposition too seriously, as the probabilities were the State Legislature would not enact the necessary legislation; at least this year.

That our views in the matter have been borne out by subsequent developments, has been forcibly demonstrated. As originally drafted, the bill made it mandatory on the city authorities to establish the plant. This has been changed to make it permissive. On last Thursday, an attempt was made to have the Senate Committee on Gas, to which the bill was referred, report it to the House, but the attempt failed, a majority of the members of the committee "treating the matter as a joke," to use the precise language of several Albany dispatches.

From what has been stated, it will be seen that there is little hope of the bill becoming a law this year, inasmuch as both branches of the legislature will adjourn the 23d of this month. In the meantime the work of "arousing public sentiment" will be prosecuted with vigor, but making due allowance for even greater success in this direction than its projectors anticipate, the municipal lighting plant will be as far from becoming a reality as it has ever been.

There are some things more potent in legislative halls than public sentiment, no matter how perfectly or admirably it may crystallize, as the advocates of this municipal lighting plant will probably discover. To borrow the words of the great English bard, this may not be as wide as a church door, or as deep as a well, but it will do.

The Frankford Steel Company has acquired the rolling-mill plant of the William and Harvey Rowland, of Frankford, Philadelphia, Pa., and are now operating the same to its utmost capacity. The company

is in a position to furnish all grades and sizes of crucible and open-hearth steel, whether hammered or rolled. The selling agents of the company are Messrs. D. E. Gautier & Co., of No. 32 Cliff street, New York city, to whom all correspondence should be addressed.

The English Steam Wagon Company was recently formed to take over the interests of the Mytholm Steam Wagon Company, of Hebden Bridge, Yorkshire, England. Their works are owned by the firm of John Pickles & Son, makers of wood-working machinery. Together with the Hungarian Wagon Company, Limited, Raab, Hungary, and the American Steam Wagon Company, Incorporated, of New York, the English company is licensed under the steam-truck patents of Arthur Herschmann. All firms report great demand for their trucks, particularly of the five-ton type. One of these five-ton trucks is expected to figure in the Commercial Contest in New York city on May 20.

CHICAGO MACHINERY MARKET.

One hears much these days about the tendency of Chicago manufacturers to abandon their plants within the city limits for sites in the suburbs or still farther out in the country. It cannot be learned that there have been many actual changes of base, but quite a number of manufacturers are now said to be looking around for locations. The unrest among labor here is the primary reason advanced for these prospective migrations, but it is urged further that the efficiency of the shops is increased by a permanency of the working forces and that this condition is more likely to prevail in the country than in the city proper, for in the crowded districts there is a large floating element that cannot be easily domesticated, while in the country the employees are the more likely to become rooted to the locality through the purchase of a home and the formation of personal associations, thus insuring the permanency of a shop force. The application of these remarks to the machinery market is that the representatives of engine and boiler makers and of other material entering into the construction of manufactories say the demand for the same in the city proper is rather weak, compared with the business that is being placed in the surrounding towns. There is a sentiment in the city, which is forbidding arrangements for construction at present by the rank and file of the manufacturers, whether or not that sentiment leads to removal.

But, regarding the market for power in its entirety, there is a good trade in progress. In looking to the present state of business, there is perhaps a tendency to make comparisons for the entire first quarter of the year with the corresponding period of 1902 or for the year to date with corresponding period, without differentiating too closely as to the more recent trend of activity. It can be said, however, that business is generally excellent. The tendency of prices, as regards power, is said to be upward, but in spite of this there is some complaint of excessive competition.

The Glucose Sugar Refining Company has bought an engine for installation at the Taylor street plant from the Fulton Iron Works, of St. Louis. It is said to have been of about 800 horse-power. The Rock Island road bought the two engines of 600 and 800 horse-power, respectively, for the new shops at Moline, Ill., from the Buckeye Engine Company. The Fox River Light, Heat & Power Company, Aurora, Ill., has bought a large engine from the Nordberg people of Milwaukee. Armour & Co. are in the market for four engines ranging from 300 to 800 horse-power each for installation at various plants.

The Stephens Engineering Company reports business conditions excellent, about on a par with those of last year, which have been described as phenomenally good.

Quotations.

NEW YORK, Monday, April 13.

New York prices for Northern and Southern irons for nearby delivery are as follows:

Northern:		
No. 1 X	$21 50 @	$21 75
No. 2 X	20 25 @	20 75
No. 2 plain	19 75 @	20 25
Southern:		
No. 1 Foundry	21 50 @	21 75
No. 2 Foundry	20 50 @	20 75
No. 3 Foundry	19 50 @	19 75
No. 4 Foundry	19 00 @	19 25

Bar Iron—Base sizes—Refined brands, mill price on dock, 1.95c. upward in carload lots. Smaller quantities from store, 2.15 @ 2.30c.

Tool Steel—Base sizes—Good standard quality, 7c.; extra grades, 10c. and upward.

Machinery Steel—Base sizes—From store, 2.10 @ 2.25c.

Cold Rolled Steel Shafting—2.90c. from store for base sizes.

Copper—Lake Superior ingot, 15 @ 15¼c.; electrolytic, 15 @ 15¼c.; casting, 14½ @ 14¾c.

Pig Tin—In 5- and 10-ton lots, f. o. b. New York, 29.80 @ 29.90c.

Pig Lead—4.67½c. in 50-ton lots.

Spelter—5.30 @ 5.50c.

Antimony—Cookson's, 8¼ @ 8½c.; Hallett's, 6¾ @ 7c.; other brands, 6½ @ 6¾c.

Lard Oil—Prime City, 85 @ 87c., according to brand and quantity, ranging from one barrel up to large lots.

Manufacturers.

H. K. Deisher is adding to his knitting mill at Kutztown, Pa.

Alderman Jeffries, Detroit, Mich., proposes a municipal brick plant.

The Peoria & Pekin Union Railway is about to build shops at Peoria, Ill.

The Coe Brass Company is rebuilding a rolling mill at Ansonia, Conn.

The Sawyer-Goodman Company, Marinette, Wis., will build a planing mill.

The Home Brewing Company, of Shenandoah, Pa., will enlarge its plant.

The Columbus (Miss.) Light & Power Company will erect a new electric plant.

The Philadelphia Car Company has bought a car factory site near Ensley, Ala.

The Keystone Emery Mills, Frankford, Philadelphia, will erect an addition.

The Chicago & Alton proposes to enlarge its premises and plant in Bloomington, Ill.

The Imperial Furniture Company, Grand Rapids, Mich., plans to build a 366x60-foot plant.

The Woronoko Street Railway Company, Westfield, Mass., is expected to increase its power.

E. Bement's Sons, Lansing, Mich., manufacturers of plows, etc., are building another factory.

The Davis Motor Works, of Waterloo, N. Y., builders of launches, etc., are locating in Geneva.

It is stated that the "Westinghouse Company" will build a manufacturing plant in Attica, N. Y.

Edward T. Fraim, manufacturer of locks, Lancaster, Pa., is about building a three-story factory.

Henry Schlueter proposes to organize a company to engage in brick manufacturing at Des Moines, Ia.

Asa Wunderly & Sons, proprietors of the Nazareth Planing Mill, will build a new mill at Nazareth, Pa.

The Atlantic Dynamite Company, of Wilmington, Del., will erect a $1,000,000 plant near Ashland, Wis.

The Niles Car & Manufacturing Company, Niles, O., is adding a new blacksmithing and machine shop plant.

The Rossendale-Reddaway Belting & Hose Company, Newark, N. J., is about to erect an extension to its plant.

A brick plant is proposed at Ottawa, Kan. A meeting of promoters has been held in the office of J. W. Pollock.

Work has begun on a 37x193½-foot, two-story mill building at Philadelphia, for the Globe Machine Works.

The American Drying Machinery Company, Philadelphia, has awarded a contract to build a factory, 52x150 feet.

Permits have been issued for a hammer and a melting shop of the Frankford Steel Company, Philadelphia.

Jay H. Newbury, manufacturer of pipe fittings, etc., Goshen, N. Y., is adding a new building to his foundry.

Work has begun on building a new plant at Woodstown, N. J., for the National Vise & Tool Works, of Camden.

The Aeolian Company, manufacturer of musical instruments, will erect an addition to its plant at Garwood, N. J.

The International Packing Company is to establish packing plants at Mexico City, Torreon and Chihuahua City, Mex.

The W. H. Denslow Company, manufacturer of heaters, Waverly, N. Y., is about to erect a foundry building, 50x70 feet.

H. E. Huntington, the railroad magnate, will found a manufacturing town near Los Angeles, Cal., and begin felt making.

The Lancaster Boiler Works Company of Lancaster, O. (capital $25,000), has been incorporated by H. H. Groff and others.

A four-story and basement factory building, 41x43½ feet, will be erected for H. J. Kaltenthaler, machinist, Philadelphia.

The Bedford Pulp & Paper Company, Richmond, Va., has contracted for the erection of a dam and power-house at Coleman's Falls, on the James River, and will also double its plant at Big Island.

The Sterlingworth Railway Supply Company, Easton, Pa., has plans completed for additions to its malleable department, increasing the present capacity thereof some 5,000 tons per annum.

A mill is to be built at Black Rock for the manufacture of cotton batting from the raw material. Plans are under way by Druar & Hunsicker, engineers and contractors, 288 Franklin street, Buffalo, N. Y.

The Consolidated Gas Company, of New York, proposes to establish at Lawrence Point, on Long Island, a plant with a daily capacity of 200,000,000 cubic feet, gradually removing its plants from Manhattan Borough.

The Jordan L. Mott Iron Works, manufacturers of plumbers' materials, etc., New York city, have contracted for a four-story building in addition to those originally planned for at their big new plant, Trenton, N. J.

The Standard Scale & Supply Company, Ltd., of Pittsburgh, Pa., has closed negotiations for a site at Beaver Falls, and will remove its plant from Bellefonte. A factory to cost $200,000 or more will be built.

It is reported from Sharon, Pa., that John Stevenson Jr., is now in Europe to secure gas engine patents and on his return will establish a large plant, and that Senator Quay, of Pittsburgh, will be interested.

A big fertilizer plant is to be established in East Macon, Ga., by the Macon Fertilizer Company, of which J. Ross Hanahan, of Charleston, S. C., will be president and R. H. Kinlock, of Montgomery, Ala., superintendent.

A contract has been closed for the erection of a $50,000 addition to the J. G. Brill (car) Company's plant, Philadelphia. The new part will include a three-story brick factory, 95x121½ feet, with a back building, 74x44 feet.

F. W. Flanley, representing the United States Packing Company, has laid before the Business Men's Association of Pueblo, Colo., a proposition to establish a large packing plant, and the project is progressing favorably.

The New England Enameling Company, of Middletown, Conn., has awarded contracts for the erection of two new buildings. One will be used for warehouse and shipping purposes; the other, 100x150 feet, for additional ovens.

"Rambo & Company" (Sidney A. Rambo?), Swedeland, Pa., will erect a building on the Warwick Furnace property, Pottstown, to manufacture a product from slag and cinder that will be used for covering steam boilers and pipes.

The contract has been let for building a $60,000 car barn and repair shop in West Newark, O. Cars on the Newark & Granville, Columbus, Buckeye Lake & Newark and the Newark & Zanesville interurban roads will be stored in the barn.

Improvements are contemplated by the Illinois Central for Clinton, Ill., including an addition to the machine shops and some $75,000 worth of machinery for them. We understand, however, that an appropriation has not yet been made.

A contract has been awarded the Pittsburg Engineering Company for the erection of a plant and the installation of machinery for the Stardard Motive Power Company. The plant is to be built at Canal Dover, Ohio, at a cost of over $1,500,000.

The Buffalo (N. Y.) Forge Company announces the removal of its Pittsburgh offices to 607 House Building, Smithfield and Water streets, affording largely increased space. As heretofore, the Pittsburgh district sales will be in charge of H. D. Wilson, M. E.

J. F. Lester, who is understood to represent the Bullock Electric Manufacturing Company, is negotiating with the city of Atlanta, Ga., to build an electric light plant which is to be run in connection with a garbage crematory and for municipal lighting, etc.

E. G. Acheson, Niagara Falls, N. Y., has secured a patent on a refractory substance called "silexicon." A company will be formed for its manufacture. He has also patented a process for clay treatment, making unusually strong brick, baked with comparatively little heat.

The Ray Automatic Machine Company, Cleveland, Ohio, has purchased six acres at Berea, seven miles west, where it will erect buildings for its several departments, viz.: machinery, nut and bolt and automobile parts. The company expects to occupy its new plant by the middle of July.

The Ford City Foundry & Machine Company is about being chartered at Harrisburg, Pa., by capitalists of Pittsburgh and Armstrong County, to establish a large plant at Ford City. It is said that the contracts for the buildings have been let and that the main one will be 120 feet wide and over 600 feet long.

There is on foot a definite project to establish at Peoria, Ill., or elsewhere, a large plant for the manufacture of electric cars. Mr. Jacobs, a practical car builder, is active in the enterprise, which is backed by Ohio capitalists, including Senator Vernon H. Burke and a member of the Cleveland banking and brokerage firm of J. A. Hoyt & Co. The Peoria Improvement Association has taken up the matter.

The National Separator & Machine Company, Manchester, N. H., successor to the Springfield Separator Company, has just been formed to manufacture oil separators and filters, turret drill presses and do all kinds of turret lathe job work. The officers of the new company are M. F. Colby, president; S. A. Baker, manager, and J. L. Porter, treasurer. The capital stock of the old company has been increased by the new one, and it intends to enlarge and put in more machinery.

The business of the Consolidated Machine Specialty Company has been purchased by the Power & Speed Controller Company, Boston, Mass. The manufacture of speed-controlling and speed-varying apparatus will be continued, with increased facilities. The factory has been enlarged and the mechanical construction and efficiency of the controllers improved. The Franklin Institute, of Philadelphia, has just awarded the Edward Longstreth medal of merit to the company's controller.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Grant. Gears. See upper corner, page 62.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks., Waltham, Mass.

Patterns. Cincinnati Pat. Wks., Cincin., O.

Experimental work. Geo. M. Mayer, M. E., Monadnock, Chicago.

Dies and Diemaking, 100 pages $1.00, post paid. J. L. Lucas, Bridgeport, Conn.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Automatic machinery designed and constructed by the Wellman Sole Cutting Machine Co., Medford, Mass.

Expert designing; industrial machinery; cost account systems installed and maintained. F. W. Brady, Englewood, N. J.

Wanted—Competent managers, superintendents and foremen. James Brady, Room J, 20th Floor, 220 Broadway, New York.

To Rent—Near Post Office, New York, light machine room, 20x70; tools for light work; 6 horse-power included; $80 per month. "Power," care AMERICAN MACHINIST.

Wanted—A Stevens pulley lathe, to turn 20 in. in diameter and 37 in. between centers; also a modern radial drill with 5 ft. arm. Adress F. A. Hooper, Glenarm, Md.

Young man, calling on engineers and machinists, would like agency for some engineering or mechanical specialty, to handle as side line. Address Box 167, AMER. MACHINIST.

Wanted—Short contributions by practical power plant engineers for a publication for steam engineers; illustrated when possible. Technical Publishing Co., Burns Bldg., Detroit, Mich.

For Sale.

For Sale—50 horse-power Miller improved gas engine; want to sell to make room for 100 horse-power engine; deliver in six weeks. The Ohio Knife Co., 9th st. and McLean ave., Cincinnati, O.

For Sale—Branch of machine tool line, well established 9 years, with domestic and foreign agencies, separate catalogs, etc., in machine tool center of the West; object, specializing. Address "Chance," care AMER. MACHINIST.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. State mentioned indicates present address of advertiser.

Situations Wanted.

CONNECTICUT.

Position in factory office in the West; age 29; married; have been in present position 16 years as errand boy, timekeeper, pay-clerk, and at present have charge of stock and tool room; modern systems used. Box 155, A. M.

Mechanical engineer, Stevens graduate, age 38, experienced designer automatic machinery, gas engines, automobiles, tools, dies, fixtures, gages and methods of manufacture for interchangeable work, desires position as superintendent, mechanical engineer or chief draftsman. Address Box 177, AMER. MACH.

ILLINOIS.

A position as foreman and designer, by a thorough toolmaker on jigs, gages, punch and dies, compound dies, etc.; 20 years' experience; best of references. Box 176, AM. MACH.

NEW JERSEY.

Draftsman, practical, technical, having 3 years' shop and drawing-room experience in tools and engines. Box 166, AM. MACH.

NEW YORK.

Machine designer, etc., wants position. Address Box 63, AMERICAN MACHINIST.

Mechanical engineer, now employed, wishes position of traveling salesman or N. Y. representative in machinery line; 12 years' experience; best of references. Box 175, A. M.

Gentlemen, do you really want a real live assistant manager or superintendent on short notice? Best references. Save both time by personal interview. "Occupied Qualified Experience," care AMERICAN MACHINIST.

Mechanical draftsman, designer with inventive ability, shop experience, expert on automatic machinery, gas engines and automobiles, wants position for part of day; New York or vicinity. Box 163, AMER. MACH.

Mechanical draftsman, 28 years old, technical graduate, 5 years' shop experience, 4 years drafting room, desires change; experience on pumping and general machinery; steam and oil engines. Box 156, AM. MACH.

OHIO.

Wanted Situation as superintendent of machine shop, by a man with practical experience in modern methods and discipline. Address Box 147, AMERICAN MACHINIST.

PENNSYLVANIA.

Position as foreman or superintendent; A1 references. Box 168, AMER. MACHINIST.

Machinist, toolmaker and designer desires responsible position; references. Box 169, AMERICAN MACHINIST.

Mechanical draftsman, technical graduate, wants position in automobile factory in Middle West. Box 136, AMER. MACHINIST.

Competent mechanical engineer on steam engines and steam turbines wishes similar position in drafting room. Box 154, AM. M.

A thoroughly practical mechanic wants position as superintendent or general foreman of jobbing shop; 16 years' experience; best reference. Address Box 160, AM. MACH.

Mechanical draftsman, technical graduate, 2 years' shop and 5 years' drafting office experience, desires change; air compressor or engine work preferred. Box 171, AM. MACH.

As manager or superintendent; modern system of production, costs and shop administration; successful handler of men; mechanical and electrical draftsman; five raises in 4 years, present employer; neither toolmaker nor speed boss, just a "mover of things." "Energetic," care AMER. MACH.

Mechanical engineer, 38, wants position as superintendent or chief draftsman; 9 years' practical shop experience; 11 years' drawing-room experience with a leading machine tool builder; at present speed boss and organizer with a manufacturing company; familiar with capacity feeds and speeds of modern machine tools and some experience at rate fixing. Box 170, AMERICAN MACHINIST.

WEST OF MISSISSIPPI.

Specialist in designing wire bending and sheet metal machinery, for lanterns, etc.; shop experience; West preferred. Box 157, AMERICAN MACHINIST.

Help Wanted.

CANADA.

Wanted—Four first-class screw machine operators; state wages expected and experience. Box 148, AMERICAN MACHINIST.

Wanted—First-class mechanic as speed boss; one who is thoroughly familiar with the capacity and the rate of speed at which all kinds of machine tools should run and the maximum cut they could take; must be thoroughly posted on modern and up-to-date methods. Apply to Canadian General Electric Company, Limited, Peterborough, Canada.

CONNECTICUT.

Wanted—Machinists; first-class men will have steady work and satisfactory pay. U. S. Rapid-Fire Gun & Power Co., Derby, Conn.

ILLINOIS.

Wanted—By Chicago manufacturing company, two first-class metal patternmakers; state age and experience. Box 173, AM. M.

Wanted—By Chicago electrical company, graduate electrical engineer, experienced in testing and assembling dynamos and motors; must be capable of taking charge of department; state age, school and where and when employed. Box 172, AMERICAN MACHINIST.

Wanted—First-class tool designer; must be familiar with modern manufacturing methods, capable of designing jigs and fixtures for small interchangeable work, and should be familiar with compound die work; large Chicago manufacturing company desires a man competent to take charge of such work. Box 174, AMERICAN MACHINIST.

INDIANA.

Machine shop foreman wanted; must be thoroughly competent; permanent position; good wages. Address Box 273, Indianapolis, Ind.

Experienced superintendent for iron working shop making modern machinery; must be able to handle men and get work out accurately at low cost without cutting wages of men; married man between 35 and 45 preferred; shop located in central Indiana; reference required. Address Box 158, AM. M.

MASSACHUSETTS.

Wanted—Machinist for lathe and milling work, also young man for office work. Apply at Boston Gear Works, Boston, Mass.

Wanted—By a concern in Eastern Massachusetts, building and manufacturing automatic machinery, with a growing business, a young man with a technical education and about 5 years' practical shop experience in this line and willing to work hard for advancement; send references as to character and ability. Box 161, AMERICAN MACHINIST.

NEW HAMPSHIRE.

Lathe, planer and erecting floor men; give experience and references. Box 123, AM. M.

NEW JERSEY.

Wanted—First-class machinists, in city near Philadelphia; steady work and good pay. The Reeves Engine Co., Trenton, N. J.

Wanted—Lathe and planer hands for night work on heavy machine tool work; good wages to good men. Apply to The Pond Machine Tool Company, Plainfield, N. J.

NEW YORK.

Wanted—Machinists for night work; steady employment. W. W. Oliver Mfg. Co., Buffalo, N. Y.

Wanted—First-class die and tool makers. Address, giving age and reference, General Electric Company, Schenectady, N. Y.

Wanted—A first-class general superintendent; must be capable of handling a large business manufacturing heavy sawmill machinery and heavy engines; age under 40 preferred. Address Clark Bros. Co., Belmont, N. Y.

Wanted—A good, experienced man as foreman in a machine shop manufacturing printing machinery, employing about 100 men; factory at Rutherford, N. J. Address, stating full particulars, including salary and experience, The Fuchs & Lang Mfg. Co., P. O. Box 844, New York.

Machinists wanted for floor or vise work, by a manufacturing concern now employing 275 men; factory located one hour's ride from New York city; wages $2.50 per day of 9 hours; open shop; no labor troubles past or present; none but sober and industrious men wanted; state age, nationality and experience for past 5 years. Box 151, AM. M.

OHIO.

Wanted—Good turret lathe hand. Apply Youngstown Mfg. Co., Youngstown, Ohio.

Wanted—Two or three first-class machinists at once; steady employment; good wages; state whether union or non-union man. Box 314, Youngstown, O.

Wanted—Lathe hands, planer hands, vise hands, milling machine hands; good wages and steady work. Apply to the Harris Automatic Press Company, Niles, O.

Machinists—Lathe, floor and vise hands; steady employment and good work in shop of about 300 men, manufacturing machine tools. Address, stating age and give full particulars regarding experience for last 5 years, Box No. 6, Station B, Cleveland, O.

Wanted—An experienced designer, by a concern going into the manufacture of forging machinery and bolt and nut machines for their own use; state where employed, give references, age and pay expected. Address reply to "Bolt & Nut," care AMER. MACH.

PENNSYLVANIA.

Lathe men, bench and vise hands wanted. Apply Searchmont Automobile Co., Trainer, Pa.

Wanted—Draftsman with some experience in machine tool designing, to make working drawings from sketches. Box 162, AM. MACH.

Wanted—First-class designers for machine tool and special work; positions permanent; state experience and salary desired. Box 164, AMERICAN MACHINIST.

First-class machine tool salesman, familiar with all standard metal working tools. Apply to Mr. Albert G. Lea, The J. R. Vandyck Co., The Bourse, Philadelphia, Pa.

Wanted—First-class foreman for machine shop; must have experience in building machine tools and interchangeable work; state experience and salary desired. Box 165, AMERICAN MACHINIST.

Salesman wanted to canvass jobbing trade in Eastern and New England States on plumbing and steamfitting tools; must be young, experienced in this line, of pleasing personality and a hustler. Address Box 471, Erie, Pa.

We are constantly increasing the scope of our work, and invite application for positions from first-class patternmakers, molders and machinists; we always have vacancies. Address The Westinghouse Machine Company, East Pittsburgh, Pa.

VERMONT.

Foreman for general machine shop; specialty, paper making machinery. Address, stating experience, with whom, length of same and lowest wages, Box 111, AMER. MACH.

WEST OF MISSISSIPPI.

Wanted—First-class mechanical engineer with best technical education. Address 63 South Robert st., St. Paul, Minn.

Wanted—One first-class patternmaker on wood patterns for seed drill work; steady work for right party; write, giving references, experience and wages wanted. Monitor Drill Co., Minneapolis, Minn.

Wanted—An up-to-date toolmaker for seed drill work; must be good on vise and lathe; must understand how to get out latest appliances in jigs and tools; steady work for right party; write, giving references, experience and wages wanted. Monitor Drill Co., Minneapolis, Minn.

WISCONSIN.

Wanted—Competent machine and bench hands. The Kempsmith Mfg. Co., Milwaukee, Wis.

Wanted—Draftsman for crane girders and similar work; must be familiar with shop practice and able to get out work quickly and accurately. Pawling & Harnischfeger, Milwaukee, Wis.

An experienced crane salesman to represent us on the road; to a man suited to our needs an excellent opportunity is offered; applications treated confidentially. Pawling & Harnischfeger, Milwaukee, Wis.

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Phelps, H. D., Ansonia, Conn.

Castings, Die Molded

Franklin Mfg. Co., Syracuse, N. Y.

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Pond Mach. Tool Co., New York.
Whiton Machine Co., D. E., New London, Conn.
Woodward & Rogers Co., Hartford, Conn.

Centers, Planer

Fay & Scott, Dexter, Me.
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.
Reed Co., F. E., Worcester, Mass.

Chains, Driving

Boston Gear Works, Boston, Mass.
Federal Mfg. Co., Cleveland, O.
Bridgeport Chain Co., Bridgeport, Conn.
Jeffrey Mfg. Co., The, Columbus, Ohio.
Link Belt Engr. Co., Phila., Pa.
Morse Chain Co., Trumansburg, N. Y.
Whitney Mfg. Co., Hartford, Ct.

Chucking Machines

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Quint, A. D., Hartford, Conn.
Reed Co., F. E., Worcester, Mass.
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Windsor Mach. Co., Windsor, Vt.

Chucks, Drill

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Brown & Co., R. H., New Haven, Conn.
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Cushman Chuck Co., Hartford, Ct.
Goodell-Pratt Co., Greenfield, Mass.
The E. Horton & Sons Co., Windsor Locks, Conn.
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Morse Twist Drill & Mch. Co., New Bedford, Mass.
Pratt Chuck Co., Frankfort, N. Y.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Lathe

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Chucks, Scroll

Whiton Mach. Co., D. E., New London, Conn.

Chucks, Split

Faneuil Watch Tool Co., Boston, Mass.
Hardinge Bros., Chicago, Ill.

Clocks, Watchman's

Nanz & Co., H., New York.

Clutches, Friction

Caldwell, Son & Co., H. W., Chicago, Ill.
Eastern Mchry. Co., New Haven, Conn.
Faneuil Watch Tool Co., Boston, Mass.
Jacobson Mach. Mfg. Co., Warren, Pa.
New Haven Mfg. Co., New Haven, Conn.
Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.
Smith, F. L., Franklin Falls, N. H.

Compound, Boiler

Harris Oil Co., A. W., Provi., R. I.

Compound, Pipe Joint

Dixon Crucible Co., Jos., Jersey City, N. J.

Compressors, Air

Blanchard Mach. Co., Boston, Mass.
Chicago Pneumatic Tool Co., Chicago, Ill.
Christensen, N. A., Milwaukee, Wis.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Gray-Blaisdell Co., Bradford, Pa.
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Jacobson Mach. Mfg. Co., Warren, Pa.
Rand Drill Co., New York.

Consulting Engineer

Thompson, Hugh L., Waterbury, Conn.

Controllers and Starters, Electric Motor

Cutler-Hammer Mfg. Co., Milwaukee, Wis.

Coping Machines

Long & Allstatter Co., Hamilton, Ohio.

Correspondence Schools

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Countershafts

Builders' Iron Fdry., Provi., R. I.
National Machine Tool Co., Cincinnati, O.
Pratt & Whitney Co., Hartford, Conn.
Reeves Pulley Co., Columbus, Ind.
Wilmarth & Morman Co., Grand Rapids, Mich.

Counterbores

Slocomb Co., J. T., Provi., R. I.

Counters, Machinery

Veeder Mfg. Co., Hartford, Conn.

Counting and Printing Wheels

Franklin Mfg. Co., Syracuse, N. Y.

Couplings, Shaft

Caldwell & Son Co., H. W., Chicago, Ill.
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Davis Mach. Co., W. P., Rochester, N. Y.
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Stuart, R. J., New Hamburg, N. Y.

Cranes

Brown Hoisting Mach. Co., N. Y. City.
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Chambersburg Engr. Co., Chambersburg, Pa.
Cleveland Crane & Car Co., Cleveland, O.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Franklin Portable Crane & Hoist Co., Franklin, Pa.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Philadel., Pa.
Whiting Foundry Equipment Co., Harvey, Ill.

Crank Pin Turning Machine

Underwood & Co., H. B., Philadelphia, Pa.

Crucibles

Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Cupolas, and Ladles, Foundry

Northern Engr. Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Philadel., Pa.
Whiting Foundry Equip. Co., Harvey, Ill.

Cutters, Milling

Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Gay & Ward, Athol, Mass.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Whitney Mfg. Co., Hartford, Conn.

Cutting-off Machines

Bement, Miles & Co., New York.
Bignall-Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Davis Mach. Co., W. P., Rochester, N. Y.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.

Cutting-off Tools

Armstrong Bros. Tool Co., Chicago, Ill.
Pratt & Whitney Co., Hartford, Conn.

Cyclometers

Veeder Mfg. Co., Hartford, Conn.

Diamond Tools

Dickinson, Thos. L., New York.
Steel Set Diamond Co., New York.

Dies, Sheet Metal

Bliss Co., E. W., Brooklyn, N. Y.
Hay-Budden Mfg. Co., Brooklyn, N. Y.
Perkins Mach. Co., So. Boston, Mass.
Wold & Co., Torris, Chicago, Ill.

Dies, Threading, Opening

Errington, F. A., New York.
Geometric Drill Co., New Haven, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Maines Mach. Co., Philadel., Pa.
Modern Tool Co., Erie, Pa.
Pratt & Whitney Co., Hartford, Conn.

Dowel Pins

Obermayer Co., S., Cincinnati, O.
Winkley Co., Hartford, Conn.

Drawing Instruments

Keuffel & Esser Co., New York.

Drilling Machines, Bench.

Barnes Co., W. F. & John, Rockford, Ill.
Pratt & Whitney Co., Hartford, Conn.

Drilling Machines, Boiler.

Aurora Tool Works, Aurora, Ind.
Baush Mch. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Bement, Miles & Co., New York.
Dallett & Co., Thos. H., Phila., Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.

Drilling Machines, Multiple Spindle

Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Barr, H. G., Worcester, Mass.
Baush Mch. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Bickford Drill & Tool Co., Cincinnati, O.
Dallett & Co., Thos. H., Phila., Pa.
Fairbanks Co., New York.
Garvin Mach. Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Newton Machine Tool Works, Philadelphia, Pa.
Niles Tool Works Co., New York.
Prentiss Tool & Supply Co., New York.
Woodward & Rogers Co., Hartford, Conn.

Drilling Machines, Pneumatic

Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneu. Tool Co., Cleveland, Ohio.
Phila. Pneumatic Tool Co., Philadelphia, Pa.
Railway Appliances Co., Chicago, Ill.
Rand Drill Co., New York.
Standard Ry. Equip. Co., St. Louis, Mo.

Drilling Machines, Portable

Dallett & Co., Thos. H., Phila., Pa.
Hisey-Wolf Mch. Co., Cincin., O.

Drilling Machines, Radial

American Tool Wks. Co., Cin., O.
Baush Mch. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Bickford Drill & Tool Co., Cincinnati, Ohio.
Cleveland Punch & Shear Works Co., Cleveland, O.
Dreses Mach. Tool Co., Cincin., O.
Fairbanks Co., New York.
Fosdick Mach. Tool Co., Cincin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Mueller Mach. Tool Co., Cincin., O.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Prentiss Tool & Supply Co., New York.
Reade Mchry. Co., Cleveland, O.

Drilling Machines, Turret

Niles Tool Works Co., New York.
Quint, A. D., Hartford, Conn.
Vanderbeek Tool Works, Hartford, Conn.

Drilling Machines, Upright
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Barr, H. G., Worcester, Mass.
Bement, Miles & Co., New York.
Brown & Zortman Mchry. Co., Pittsburg, Pa.
Cincinnati Mach. Tool Co., Cin., O.
Davis Mach. Co., W. P., Rochester, N. Y.
Dwight Slate Mach. Co., Hartford, Conn.
Fairbanks Co., New York.
Fosdick Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Niles Tool Works Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Sibley & Ware, South Bend, Ind.
Washburn Shops, Worcester, Mass.
Whitney Mfg. Co., Hartford, Conn.
Woodward & Rogers Co., Hartford, Conn.

Drills, Center
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Providence, R. I.

Drills, Rail
Bement, Miles & Co., New York.
Niles Tool Works Co., New York.

Drills, Ratchet
Parker Co., Chas., Meriden, Ct.
Pratt & Whitney Co., Hartford, Conn.

Dust Collectors
Allington & Curtis Mfg. Co., Saginaw, Mich.

Dynamos
Akron Elec. Mfg. Co., Akron, O.
C & C Electric Co., New York.
Christensen Engineering Co., Milwaukee, Wis.
Commercial Electric Co., Indianapolis, Ind.
Crocker-Wheeler Electric Co., Ampere, N. J.
Eck Dynamo & Motor Co., Belleville, N. J.
General Elec. Co., New York.
Jantz & Leist Elec. Co., Cincin., O.
Mechanical Appliance Co., Milwaukee, Wis.
Milwaukee Elec. Co., Milwaukee, Wis.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Sprague Elec. Co., New York.
Storey Motor & Electric Co., Harrison, N. J.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.

Electrical Supplies
Akron Elec. Mfg. Co., Akron, O.
Commercial Electric Co., Indianapolis, Ind.
General Elec. Co., New York.
Milwaukee Elec. Co., Milwaukee, Wis.
Storey Motor & Electric Co., Harrison, N. J.
Triumph Electric Co., Cincin., O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Elevators
Albro-Clem Elevator Co., Philadelphia, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Howard Iron Wks., Buffalo, N. Y.
Morse, Williams & Co., Phila., Pa.

Emery Wheels
See Grinding Wheels.

Enamel, Machinery
Felton, Sibley & Co., Phila., Pa.

Enclosures, Tool-room
Merritt & Co., Philadelphia, Pa.

Engines, Automobile
Olds Motor Works, Lansing, Mich.

Engines, Gas and Gasoline
Foos Gas Eng. Co., Springfield, O.
Middletown Mach. Co., Middletown, O.
Mietz, August, New York.
National Engine Co., Rockford, Ill.
New Era Iron Wks., Dayton, O.
Olds Motor Wks., Lansing, Mich.
Regal Gasoline Engine Co., Coldwater, Mich.
Stover Engine Works, Freeport, Ill.
Struthers-Wells Co., Warren, Pa.

Engines, Steam
Buffalo Forge Co., Buffalo, N. Y.
Chandler & Taylor Co., Indianapolis, Ind.
Frick Co., Waynesboro, Pa.
Rand Drill Co., New York.
Struthers-Wells Co., Warren, Pa.

Exhaust Fans
Buffalo Forge Co., Buffalo, N. Y.

Fans, Electric
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Feed Water Heater and Purifier
Hawley Down Draft Furnace Co., Chicago, Ill.

Files and Rasps
Barnett Co., G. & H., Phila., Pa.
Hammacher, Schlemmer & Co., New York.
Nicholson File Co., Provi., R. I.
Patterson, Gottfried & Hunter, Ltd., New York.

Filing Machines
Cochrane-Bly Mach. Co., Rochester, N. Y.

Fillers, Oil Can
The Winkley Co., Hartford, Conn.

Fittings, Steam
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Jenkins Bros., New York.
Lunkenheimer Co., Cincinnati, O.
Walworth Mfg. Co., Boston, Mass.

Flexible Shafts
Chicago Flexible Shaft Co., Chicago, Ill.

Forges
Buffalo Forge Co., Buffalo, N. Y.
Patterson, Gottfried & Hunter, Ltd., New York.

Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
Hay-Budden Mfg. Co., Brooklyn, N. Y.
Westmoreland Steel Co., Pittsburg, Pa.
Wyman & Gordon, Worcester, Mass.

Foundry Furnishings
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Philadel., Pa.
Smith Fdry. Supply Co., J. D., Cleveland, O.
Whiting Foundry Equip. Co., Harvey, Ill.

Furnaces, Coal and Oil
Buffalo Forge Co., Buffalo, N. Y.
Hawley Down Draft Furnace Co., Chicago, Ill.
Jacobson Mach. Mfg. Co., Warren, Pa.
Obermayer Co., S., Cincinnati, O.

Furnaces, Gas
Am. Gas Furnace Co., N. Y. City.
Chicago Flexible Shaft Co., Chicago, Ill.

Furniture, Machine Shop
New Britain Mach. Co., New Britain, Conn.

Gages, Recording
Bristol Co., Waterbury, Conn.

Gages, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gages, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Gear Cutting Machinery
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bultman & Co., F. W., Cleveland, Ohio.
Dwight Slate Mach. Co., Hartford, Conn.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Newton Mch. Tool Wks., Phil., Pa.
Niles Tool Works Co., New York.
Whiton Machine Co., D. E., New London, Conn.

Gears, Cut
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Works, Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bultman & Co., F. W., Cleveland, Ohio.
Fawcus Mach. Co., Pittsburgh, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott, Cleveland, O.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Philadelphia Gear Works, Philadelphia, Pa.
Sawyer Gear Wks., Cleveland, O.
Simonds Mfg. Co., Pittsburgh, Pa.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cincin., O.

Gears, Rawhide
Chicago Raw Hide Co., Chicago, Ill.
Fawcus Mch. Co., Pittsburgh, Pa.
Horsburgh & Scott, Cleveland, O.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Fawcus Mach. Co., Pittsburgh, Pa.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburgh, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. J.
Lubriphite Co., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Center
Heald & Son, L. S., Barre, Mass.
Hisey-Wolf Mach. Co., Cincin., O.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter
Adams Co., Dubuque, Iowa.
Automatic Mach. Co., Greenfield, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Machine Co., New York.
Norton Emery Wheel Co., Worcester, Mass.

Grinders, Cutter—*Continued*
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.
Woodward & Rogers Co., Hartford, Conn.

Grinders, Disc
Besly & Co., Chas. H., Chicago, Ill.
Gorton Mach. Co., Geo., Racine, Wis.
Iroquois Mach. Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.

Grinders, Drill
Gorton Mach. Co., Geo., Racine, Wis.
Heald & Son, L. S., Barre, Mass.
Standard Tool Co., Cleveland, O.
Washburn Shops, Worcester, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Tool
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Barr, H. G., Worcester, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Diamond Mach. Co., Provi., R. I.
Gisholt Mach. Co., Madison, Wis.
Landis Tool Co., Waynesboro, Pa.
Modern Tool Co., Erie, Pa.
Northampton Emery Wheel Co., Leeds, Mass.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, O.
Throop Perforating Co., Buffalo, N. Y.
Whitney Mfg. Co., Hartford, Ct.

Grinding Machines
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Fairbanks Co., New York.
Falkenau-Sinclair Co., Phila., Pa.
Goodell-Pratt Co., Greenfield, Mass.
Gorton Mach. Co., Geo., Racine, Wis.
Greenfield Mach. Co., Greenfield Mass.
Hill, Clarke & Co., Boston, Mass.
Hisey-Wolf Mch. Co., Cincin., O.
Iroquois Mach. Co., New York.
Landis Tool Co., Waynesboro, Pa.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Mechanical Appliance Co., Milwaukee, Wis.
Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.
Norton Grinding Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, Ohio.
Throop Perforating Co., Buffalo, N. Y.
Vitrified Wheel Co., Westfield, Mass.
Washburn Shops, Worcester, Mass.
Webster & Perks Tool Co., Springfield, O.
Wilmarth & Morman Co., Grand Rapids, Mich.
Woodward & Rogers Co., Hartford, Conn.

Grinding Wheels
Builders' Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Diamond Mach. Co., Provi., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Vitrified Wheel Co., Westfield, Mass.
Whitney Mfg. Co., Hartford, Conn.

Grindstone Frames
Standard Tool Co., Athol, Mass.

Gun Barrel Machinery
Bement, Miles & Co., New York.
Diamond Mach. Co., Provi., R. I.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Reed Co., F. E., Worcester, Mass.

Hack Saw Blades and Frames
Diamond Saw & Stamping Wks., Buffalo, N. Y.
Goodell-Pratt Co., Greenfield, Mass.
Hammacher, Schlemmer & Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Starrett Co., L. S., Athol, Mass.
West Haven Mfg. Co., New Haven, Conn.

Hack Saws, Power
Diamond Saw & Stamping Wks., Buffalo, N. Y.
Hoefer Mfg. Co., Freeport, Ill.
Resek Mach. Tool Co., Cleveland, Ohio.
West Haven Mfg. Co., New Haven, Conn.

Hammers, Drop
Bement, Miles & Co., New York.
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Merrill Bros., Brooklyn, N. Y.
Mossberg & Granville Mfg. Co., Providence, R. I.
Perkins Mach. Co., Boston, Mass.

Hammers, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Dallett & Co., Thos. H., Phila., Pa.
Phila. Pneu. Tool Co., Philadelphia, Pa.
Railway Appliances Co., Chicago, Ill.
Rand Drill Co., New York.
Standard Ry. Equip. Co., St. Louis, Mo.

Hammers, Power
Scranton & Co., The, New Haven, Conn.

Hammers, Steam
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Chambersburg Engr. Co., Chambersburg, Pa.
Cleveland Punch & Shear Wks. Co., Cleveland, O.

Heating and Ventilating Apparatus
Buffalo Forge Co., Buffalo, N. Y.

Heating Machines, Automatic
Am. Gas Furnace Co., New York.

Hoisting and Conveying Machinery
Brown Hoisting Mchry. Co., New York.
Caldwell & Son Co., H. W., Chicago, Ill.
Eastern Mchry. Co., New Haven, Conn.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

Hoists, Electric
C & C Electric Co., New York.
Hunt Co., C. W., West New Brighton, N. Y.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger, Milwaukee, Wis.
Sprague Electric Co., New York.

Hoists, Hand
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Northern Engineering Wks., Detroit, Mich.
Rand Drill Co., New York.

Igniters, Gas Engine
Dayton Electrical Mfg. Co., Dayton, O.

Indicators, Speed
Starrett Co., L. S., Athol, Mass.

Indicators, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Injectors
Lunkenheimer Co., Cincinnati, O.
Sellers & Co., Wm., Phila., Pa.

Inspection and Tests
Hunt Co., Robt. W., Chicago, Ill.

Instruction Schools
See Schools, Correspondence.

Insurance, Boiler
Hartford Steam Boiler Insp. & Ins. Co., Hartford, Conn.

Jacks, Hydraulic
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Jack Planer
Armstrong Bros. Tool Co., Chicago, Ill.

Key Seaters
Baker Bros., Toledo, O.
Bement, Miles & Co., New York.
Chattanooga Mchry. Co., Chattanooga, Tenn.
Davis Mach. Co., W. P., Rochester, N. Y.
Mitts & Merrill, Saginaw, Mich.
Whitney Mfg. Co., Hartford, Conn.

Keys, Machine
Standard Gauge Steel Co., Beaver Falls, Pa.
Whitney Mfg. Co., Hartford, Ct.

Lamps, Arc
General Electric Co., N. Y. City.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Lathe Attachments
National Machine Tool Co., Cincinnati, O.

Lathe Dogs
Armstrong Bros. Tool Co., Chicago, Ill.
Besly & Co., Chas. H., Chicago, Ill.
Hill Tool Co., Anderson, Ind.
Le Count, Wm. G., So. Norwalk, Conn.
Pratt & Whitney Co., Hartford, Conn.
Tindel-Morris Co., Eddystone, Pa.

Lathes
American Tool Wks. Co., Cin., O.
Automatic Mach. Co., Greenfield, Mass.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bement, Miles & Co., New York.
Bradford Mach. Tool Co., Cin., O.
Brown & Zortman Mchry. Co., Pittsburg, Pa.
Bullard Mach. Tool Co., Bridgeport, Conn.
Davis Mach. Co., W. P., Rochester, N. Y.
Diamond Machine Co., Prov., R. I.
Draper Mach. Tool Co., Worcester, Mass.
Fairbanks Co., New York.
Fay & Scott, Dexter, Me.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Greaves, Klusman Co., Cincin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mch. Tool Co., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Milwaukee Machine Tool Co., Milwaukee, Wis.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Reed Co., F. E., Worcester, Mass.
Schumacher & Boye, Cincinnati, Ohio.
Sebastian Lathe Co., Cincin., O.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Washburn Shops, Worcester, Mass.

Lathes, Automatic Screw-Threading
Automatic Machine Co., Bridgeport, Conn.

Lathes, Bench
Faneuil Watch Tool Co., Boston, Mass.
Hardinge Bros., Chicago, Ill.
Loop-Lock Mach. Co., Waltham, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Lathes, Boring
Streit Mach. Co., A., Cincin., O.

Lathes, Wood
American Machinery Co., Grand Rapids, Mich.

Letters, Pattern
Brim, A. W., Seneca Falls, N. Y.
Butler, A. G., N. Y. City.

Levels
Mass. Tool Co., Greenfield, Mass.
Starrett Co., L. S., Athol, Mass.

Lockers, Clothes
Merritt & Co., Philadelphia, Pa.
Narragansett Mach. Co., Providence, R. I.

Locomotives, Shop
Hunt Co., C. W., West New Brighton, N. Y.

Lubricants
Besly & Co., Chas. H., Chicago, Ill.
Dixon Crucible Co., Jos., Jersey City, N. J.
Lubriphite Co., Jersey City, N. J.

Lubricators
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lubriphite Co., Jersey City, N. J.
Lunkenheimer Co., Cincinnati, O.

Machine Screws
Atlantic Mach. Screw Co., Boston, Mass.
Worcester Mach. Screw Co., Worcester, Mass.

Machinery Builders, Special
American Fdry. & Mach. Co., Hanover, Pa.
Blanchard Mach. Co., The, Boston, Mass.
Eclipse Mach. Co., Cleveland, O.
Fawcus Mch. Co., Pittsburgh, Pa.
Hart, Fredk., Poughkeepsie, N. Y.
Hoefer Mfg. Co., Freeport, Ill.
Pratt & Whitney Co., Hartford, Conn.
Rhodes, L. E., Hartford, Conn.
Simonds Mfg. Co., Pittsburgh, Pa.
Woodward & Rogers Co., Hartford, Conn.

Machinists' Small Tools
Besly & Co., Chas. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
McCrosky & Huber, Cincinnati, O.
Mass. Tool Co., Greenfield, Mass.
Patterson, Gottfried & Hunter, Ltd., New York.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Provi., R. I.
Standard Tool Co., Athol, Mass.
Standard Tool Co., Cleveland, O.
Starrett Co., L. S., Athol, Mass.
Wyke & Co., J., E. Boston, Mass.

Machinists' Supplies
Hammacher, Schlemmer & Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.

Mandrels, Expanding
Nicholson & Son, W. H., Wilkesbarre, Pa.

Mandrels, Solid
Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Measuring Machines
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.

Metal, Bearing
Besly & Co., Chas. H., Chicago, Ill.
Patterson, Gottfried & Hunter, Ltd., New York.

Metal, Perforated
Throop Perforating Co., Buffalo, N. Y.

Micrometer Calipers
Brown & Sharpe Mfg. Co., Providence, R. I.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

Milling Attachments
The Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Kempsmith Mfg. Co., Milwaukee, Wis.
Whitney Mfg. Co., Hartford, Conn.

Milling Machines, Bench
Faneuil Watch Tool Co., Boston, Mass.
Hill, Clarke & Co., Boston, Mass.
Loop-Lock Mach. Co., Waltham, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Horizontal
Adams Co., Dubuque, Iowa.
Beaman & Smith Co., Prov., R. I.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bement, Miles & Co., New York.
Hendey Mach. Co., Torrington, Ct.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Milling Machines, Plain
American Tool Wks. Co., Cin., O.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Fairbanks Co., New York.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Marshall & Huschart Mchry. Co., Chicago, Ill.
McCabe, J. J., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Universal
American Tool Wks. Co., Cin., O.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Fairbanks Co., New York.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Marshall & Huschart Mchry. Co., Chicago, Ill.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Portable
Underwood & Co., H. B., Philadelphia, Pa.

Milling Machines, Vertical
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Garvin Mach. Co., New York.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mch. Tool Works, Philadelphia, Pa.
Niles Tool Works Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Pratt & Whitney Co., Hartford, Conn.
Quint, A. D., Hartford, Conn.

Milling Tools, Adjustable
Geometric Drill Co., New Haven, Conn.
Rogers, Boat, Gage & Drill Wks., John M., Gloucester City, N. J.

Molds, Hammer and Vise Jaw
Field, Chas. H., Providence, R. I.

Molding Machines
Adams Co., The, Dubuque, Iowa.
American Foundry & Mach. Co., Hanover, Pa.
Tabor Mfg. Co., Philadelphia, Pa.
Webster & Perks Tool Co., Springfield, O.

Motors, Electric
Akron Elec. Mfg. Co., Akron, O.
C & C Electric Co., New York.
Christensen Engr. Co., Milwaukee, Wis.
Commercial Electric Co., Indianapolis, Ind.
Crocker-Wheeler Co., Ampere, N.J.
Eck Dynamo & Motor Wks., Belleville, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Mechanical Appliance Co., Milwaukee, Wis.
Milwaukee Elec. Co., Milwaukee, Wis.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Sprague Electric Co., New York.
Storey Motor & Electric Co., Harrison, N. J.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Name Plates
Franklin Mfg. Co., Syracuse, N. Y.
G. & P. Engraving Co., Boston, Mass.
Murdock Corporations, Boston, Mass.

Nut Tappers
See Bolt and Nut Machinery.

Oil Cups and Covers
Bay State Stamping Works, Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Bown Machine Works, Battle Creek, Mich.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.
Tucker, W. W. & C. F., Hartford, Conn.
The Winkley Co., Hartford, Conn.

Oils
Besly & Co., Chas. H., Chicago, Ill.
Harris Oil Co., A. W., Provi., R. I.

Oils, Slushing
Harris Oil Co., A. W., Provi., R. I.

Oil Stones
Pike Mfg. Co., Pike Station, N. H.

Packing, Steam Joint
Jenkins Bros., New York.
N. Y. Belting & Packing Co., New York.
Peerless Rubber Mfg. Co., New York.

Paint, Macainery
Felton, Sibley & Co., Phila., Pa.

Pans, Lathe
New Britain Mch. Co., New Britain, Conn.

Pans, Shop
Kilbourne & Jacobs Mfg. Co., Columbus, O.

Patents
Baldwin, Davidson & Wight, Washington, D. C.
Frothingham, N. L., New York.
Stevens & Co., Milo B., Washington, D. C.

Pattern Shop Machinery
American Machinery Co., Grand Rapids, Mich.
Baker Bros., Toledo, O.
Brown & Zortman Mchry. Co., Pittsburg, Pa.
Fairbanks Co., New York.
Fay & Scott, Dexter, Me.
Field, Chas. H., Providence, R. I.
Greaves, Klusman & Co., Cin., O.
Prentiss Tool & Supply Co., New York.
Washburn Shops, Worcester, Mass.

Patterns, Wood
Hartford Pattern & Model Co., Hartford, Conn.

Pencils
Keuffel & Esser Co., New York.

Phosphor Bronze
Phosphor Bronze Smelting Co., Philadelphia, Pa.

Pinion Cutters
Loop-Lock Mach. Co., Waltham, Mass.

Pipe and Fittings
Crane Co., Chicago, Ill.

Pipe Cutting and Threading Machines
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Curtis & Curtis Co., Bridgeport, Conn.
Merrell Mfg. Co., Toledo, O.
Oster Mfg. Co., Cleveland, O.
Reed Mfg. Co., Erie, Pa.
Saunders' Sons, D., Yonkers, N. Y.
Wells Bros. Co., Greenfield, Mass.

Pipe Fitters' Tools
Cleveland Twist Drill Co., Cleveland, O.
Saunders' Sons, D., Yonkers, N. Y.
Standard Tool Co., Cleveland, O.

Planers
American Tool Wks. Co., Cin., O.
Belmer Mach. Tool Co., Cin., O.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del
Cincinnati Planer Co., Cincin., O.
Detrick & Harvey Mch. Co., Baltimore, Md.
Fairbanks Co., New York.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Gray Co., G. A., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Pond Mach. Tool Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Wm., Phila., Pa.
Whitcomb Mfg. Co., Worcester, Mass.
Woodward & Powell Planer Co., Worcester, Mass.

Planers, Bench
Bartlett, E. E., Boston, Mass.

Planers, Portable
Morton Mfg. Co., Muskegon Heights, Mich.
Underwood & Co., H. B., Philadelphia, Pa.

Planers, Rotary
Bement, Miles & Co., New York.
Cleveland Punch & Shear Works, Cleveland, O.
Newton Mach. Tool Wks., Philadelphia, Pa.
Pond Mach. Tool Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Presses, Hand
Perkins Mach. Co., So. Boston, Mass.

Presses, Hydraulic
Watson-Stillman Co., New York.

Presses, Power
Automatic Mach. Co., Bridgeport, Conn.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Chambersburg Engr. Co., Chambersburg, Pa.
Fairbanks Co., New York.
Mossberg & Granville Mfg. Co., Providence, R. I.
Perkins Mach. Co., So. Boston, Mass.
Prentiss Tool & Supply Co., New York.
Wold & Co., Torris, Chicago, Ill.

Profilers
Garvin Mach. Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Pulleys
American Pulley Co., Phila., Pa.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Federal Mfg. Co., Cleveland, O.
Howard Iron Wks., Buffalo, N. Y.
Oneida Steel Pulley Co., Oneida, N. Y.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.
The Xylotite Co., Cincinnati, O.

Pulleys, Friction Cone
Evans Friction Cone Co., Boston, Mass.

Pulleys, Speed Changing
Speed Changing Pulley Co., Indianapolis, Ind.

Pulley Turning and Boring Machines
Harrington, Son & Co., Edwin, Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Streit Mach. Co., A., Cincin., O.

Pumps, Hydraulic
Watson-Stillman Co., New York.

Punches, Hydraulic
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Punches, Power
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cincinnati Punch & Shear Co., Cincinnati, O.
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Perkins Mach. Co., S. Boston, Mass.
Reade Mchry. Co., Cleveland, O.

Rack Cutting Machines
Fellows Gear Shaper Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Reed Co., F. E., Worcester, Mass.

Racks, Cut
Fellows Gear Shaper Co., Springfield, Vt.
Nuttall Co., R. D., Pittsburgh, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.
Standard Gauge Steel Co., Beaver Falls, Pa.

Racks, Tool
New Britain Mach. Co., New Britain, Conn.

Reamers
Chadwick & Co., G. B., Portsmouth, N. H.
Cleveland Twist Drill Co., Cleveland, O.
Clough, R. M., Tolland, Conn.
McCrosky & Huber, Cincinnati, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
New Process Twist Drill Co., Taunton, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.

Reaming Stands
Flather Planer Co., Mark, Nashua, N. H.

Rheostats
Cutler-Hammer Mfg. Co., Milwaukee, Wis.

Riveters, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Riveters, Pneumatic
Bement, Miles & Co., New York.
Cleveland Pneumatic Tool Co., Cleveland, O.
Philadelphia Pneumatic Tool Co., Philadelphia, Pa.
Railway Appliances Co., Chicago, Ill.
Rand Drill Co., New York.
Standard Ry. Equip. Co., St. Louis, Mo.

Riveting Machines
Bement, Miles & Co., New York.
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Chambersburg Engr. Co., Chambersburg, Pa.
Long & Allstatter Co., Hamilton, Ohio.
Perkins Mach. Co., So. Boston, Mass.

Roller and Ball Bearings
American Roller Bearing Co., Boston, Mass.
Ball Bearing Co., Philadel., Pa.
Bantam Mfg. Co., Bantam, Conn.
Mossberg & Granville Mfg. Co., Providence, R. I.

Rolling Mill Machinery
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Mossberg & Granville Mfg. Co., Providence, R. I.
Pratt & Whitney Co., Hartford, Conn.

Rubber Goods, Mechanical
N. Y. Belting & Packing Co., New York.
Peerless Rubber Mfg. Co., New York.

Rules, Steel
Mass. Tool Co., Greenfield, Mass.
Sawyer Tool Co., Fitchburg, Mass.
Slocomb Co., J. T., Provi., R. I.
Starrett Co., L. S., Athol, Mass.

Safety Valves, Pop
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.

Sand Blast Apparatus
Paxson Co., J. W., Philadel., Pa.

Sand Mixing Machines
Obermayer Co., S., Cincinnati, O.
Smith Fdry. Supply Co., Cleveland, O.

Sawing Machines, Metal
Cleveland Punch & Shear Works Co., Cleveland, O.
Cochrane-Bly Mach. Works, Rochester, N. Y.
Newton Mach. Tool Works, Philadelphia, Pa.
Pratt & Whitney Co., Hartford, Conn.
Reade Mchry. Co., Cleveland, O.
Resek Mch. Tool Co., Cleveland, O.
West Haven Mfg. Co., New Haven, Conn.

Sawing Machines, Wood
American Machinery Co., Grand Rapids, Mich.
Brown & Zortman Mchry. Co., Pittsburg, Pa.

Schools, Correspondence
Amer. School of Correspondence, Chicago, Ill.
Consolidated Schools, N. Y. City.
International Correspond. Schools, Scranton, Pa.

Schools, Technical
State College of Ky., Lexington, Ky.

Screw Machines, Automatic
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Dreses Mach. Tool Co., Cincin., O.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Windsor Mach. Co., Windsor, Vt.

Screw Machines, Hand

Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Draper Mach. Tool Co., Worcester, Mass.
Garvin Mach. Co., New York.
Jones & Lamson Mch. Co., Springfield, Vt.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Screw Machinery, Wood and Lag

Baker Bros., Toledo, Ohio.
Cook Co., Asa S., Hartford, Conn.

Screw Plates

Besly & Co., Chas. H., Chicago, Ill.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Card Mfg. Co., S. W., Mansfield, Mass.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Oster Mfg. Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Second Hand Machinery

Baird Machy. Co., Pittsburg, Pa.
Bennett, G. L., New York.
Bowler & Co., Geo. H., Cleveland, Ohio.
Brown & Zortman Mchry. Co., Pittsburg, Pa.
Carlin Mchry. & Supply Co., Allegheny, Pa.
Fairbanks Co., New York.
Fairbanks Co., Philadelphia, Pa.
Garvin Mch. Co., New York.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mchry. Co., Chicago, Ill.
McCabe, J. J., New York.
Niles-Bement-Pond Co., New York.
Packard Machinery Co., O. L., Chicago, Ill.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Toomey, Frank, Philadelphia, Pa.
Wickes Bros., New York.
Wormer Machy. Co., C. C., Detroit, Mich.

Separators, Oil

American Tool & Mch. Co., Boston, Mass.
National Separator & Mch. Co., Manchester, N. H.

Shapers

American Tool Wks. Co., Cin., O.
Barker & Co., Wm., Cincinnati, O.
Bement, Miles & Co., New York.
Cincinnati Shaper Co., Cincin., O.
Fairbanks Co., New York.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Gould & Eberhardt, Newark, N. J.
Hendey Mch. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kelly Co., R. A., Xenia, Ohio.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Morton Mfg. Co., Muskegon Heights, Mich.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Perkins Mach. Co., So. Boston, Mass.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Prentiss Tool & Supply Co., New York.
Steptoe Shaper Co., John, Cincinnati, O.

Shears, Power

Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cincinnati Punch & Shear Co., Cincinnati, O.
Cleveland Punch & Shear Works, Cleveland, O.
Hilles & Jones Co., Wilmington, Del.

Shears, Power—*Continued*

Long & Allstatter Co., Hamilton, Ohio.
Perkins Mach. Co., So. Boston, Mass.
Reade Mchry. Co., Cleveland, O.

Shears, Rotary

Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.
Perkins Mach. Co., So. Boston, Mass.

Shelving, Shop

New Britain Mach. Co., New Britain, Conn.

Slide Rests

Bartlett, E. E., Boston, Mass.
Reed Co., F. E., Worcester, Mass.
Rhodes, L. E., Hartford, Conn.

Slotters

Baker Bros., Toledo, Ohio.
Barr, H. G., Worcester, Mass.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Garvin Mach. Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.

Sockets and Sleeves

New Process Twist Drill Co., Taunton, Mass.

Sprocket Chains

See Driving Chains.

Stampings, Sheet Steel

Federal Mfg. Co., Cleveland, O.

Stamps, Steel

Schwerdtle Stamp Co., Bridgeport, Conn.

Steel, Machinery

Boker & Co., Hermann, New York.
Patriarche & Bell, New York.
Ward & Son, Edgar T., Boston, Mass.

Steel, Sheet

Federal Mfg. Co., Cleveland, O.
Ward & Son, Edgar T., Boston, Mass.

Steel, Tool

Boker & Co., Hermann, New York.
Firth-Sterling Steel Co., Demmler, Pa.
Patriarche & Bell, New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Westmoreland Steel Co., Pittsburg, Pa.

Stones, Oil

Pike Mfg. Co., Pike Station, N. H.

Straightener, Hydraulic

Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Swaging Machines

Excelsior Needle Co., Torrington, Conn.
Mossberg & Granville Mfg. Co., Providence, R. I.

Switchboards

C & C Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Tapping Machines and Attachments

Baker Bros., Toledo, O.
The Beaman & Smith Co., Providence, R. I.
Bickford Drill & Tool Co., Cin., O.
Cincinnati Mach. Tool Co., Cincinnati, O.
Errington, F. A., N. Y. City.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Geometric Drill Co., New Haven, Conn.
Modern Tool Co., Erie, Pa.
Murray Mfg. Co., Richmond Valley, S. I., N. Y.
Pratt & Whitney Co., Hartford, Conn.
Quint, A. D., Hartford, Conn.
Webster & Perks Tool Co., Springfield, O.
Whitney Mfg. Co., Hartford, Conn.
Woodward & Rogers Co., Hartford, Conn.

Taps, Collapsing

Geometric Drill Co., New Haven, Conn.

Taps and Dies

Besly & Co., Chas. H., Chicago, Ill.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Crane Co., Chicago, Ill.
Geometric Drill Co., New Haven, Conn.
Hammacher, Schlemmer & Co., New York.
Hardinge Bros., Chicago, Ill.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Oster Mfg. Co., Cleveland, O.
Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.
Webster & Perks Tool Co., Springfield, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Telephone System

Clark Auto. Telephone Switch Board Co., Providence, R. I.

Thread Cutting Tools

Besly & Co., Chas. H., Chicago, Ill.
Hart Mfg. Co., Cleveland, O.
Oster Mfg. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Tool Holders

Armstrong Bros. Tool Co., Chicago, Ill.
Hill Tool Co., Anderson, Ind.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
McCrosky & Huber, Cincinnati, O.

Tools, Small

See Machinists' Small Tools.

Tracing Cloth

Hardtmuth, L. & C., New York.

Transmission Machinery

American Pulley Co., Phila., Pa.
Caldwell & Son Co., H. W., Chicago, Ill.
Case Mfg. Co., Columbus, O.
Cresson & Co., Geo. V., Phila., Pa.
Federal Mfg. Co., Cleveland, O.
Link-Belt Engineering Co., Philadelphia, Pa.
National Machine Tool Co., Cincinnati, O.
Oneida Steel Pulley Co., Oneida, N. Y.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.

Trimmers, Wood

American Machinery Co., Grand Rapids, Mich.
Washburn Shops, Worcester, Mass.

Trolleys and Tramways

Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Maris Bros., Philadelphia, Pa.
Yale & Towne Mfg. Co., New York.

Tubing, Steel

Shelby Steel Tube Co., Pittsburgh, Pa.

Turret Machines

Amer. Tool & Machine Co., Boston, Mass.
Automatic Mach. Co., Greenfield, Mass.
Bradford Mach. Tool Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Mach. Tool Co., Bridgeport, Conn.
Dreses Mach. Tool Co., Cincin., O.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Gisholt Mch. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Jones & Lamson Mch. Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.

Turret Machines—*Continued*

Lodge & Shipley Mach. Tool Co., Cincinnati, O.
Milwaukee Mach. Tool Co., Milwaukee, Wis.
Niles Tool Works Co., New York.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnson Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Turrets, Carriage

Fay & Scott, Dexter, Me.

Twist Drills

Cleveland Twist Drill Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
Morse Twist Drill & M. Co., New Bedford, Mass.
New Process Twist Drill Co., Taunton, Mass.
Patterson, Gottfried & Hunter, Ltd., New York.
Standard Tool Co., Cleveland, O.

Universal Joints

Baush Machine Tool Co., Springfield, Mass.
Vanderbeek Tool Wks., Hartford, Conn.
Waterbury Tool Co., Waterbury, Conn.

Valves

See Steam Fittings.

Vises, Drill

Graham Mfg. Co., Provi., R. I.
Jacobson Mach. Mfg. Co., Warren, Pa.

Vises, Metal Workers'

Hammacher, Schlemmer & Co., New York.
Hanna, E. E., Chicago, Ill.
Howard Iron Wks., Buffalo, N. Y.
Jacobson Mach. Mfg. Co., Warren, Pa.
Parker Co., Chas., Meriden, Conn.
Reed Mfg. Co., Erie, Pa.
Standard Tool Co., Athol, Mass.
Walworth Mfg. Co., Boston, Mass.

Vises, Pipe

Curtis & Curtis Co., Bridgeport, Conn.
Saunders' Sons, D., Yonkers, N. Y.
Walworth Mfg. Co., Boston, Mass.

Vises, Planer and Shaper

Cincinnati Planer Co., Cincin., O.
Hendey Mach. Co., Torrington, Ct.
Pratt & Whitney Co., Hartford, Conn.

Vises, Wood Workers'

Emmert Mfg. Co., Waynesboro, Pa.
Hammacher, Schlemmer & Co., New York.
Wyman & Gordon, Worcester, Mass.

Welding Machines

Long & Allstatter Co., Hamilton, Ohio.

Wire-Drawing Machinery

Iroquois Mach. Co., New York.
Mossberg & Granville Mfg. Co., Providence, R. I.

Wire-Forming Machinery

Automatic Mach. Co., Bridgeport, Conn.

Wire-Straightening Machinery

Hoefer Mfg. Co., Freeport, Ill.

Wood Working Machinery

American Machinery Co., Grand Rapids, Mich.

Worm Hobbing Machines

Pratt & Whitney Co., Hartford, Conn.

Worm Milling Machines

Cleveland Automatic Mach. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.

Wrenches

Coes Wrench Co., Worcester, Mass.
Standard Tool Co., Athol, Mass.

Wrenches, Drop Forged

Billings & Spencer Co., Hartford, Conn.

Duplex Milling Machine.

The accompanying engravings illustrate a duplex milling machine of a novel design, the columns of this tool being arranged to feed the cutters along the work while the work itself is held stationary on a pair of tables. The uprights and tables are adjustable, longitudinally, on the bed; these being indicated by dotted lines in the plan view in Fig. 2—and driven by a 3½-inch belt from a countershaft intended to run at 340 turns per minute. The spindles are geared in the ratios of 40 and 16 to 1; and, with the cone pulley drive, eight spindle speeds are obtained, these ranging from 6 to 30 turns per minute. The column screw. The bracket carrying the worm shaft is pivoted on the shaft at the back and on the completion of the cut is automatically dropped to release the feed. The levers for shifting the worm bracket by hand and the stop for the automatic release are plainly shown at the side of the saddle.

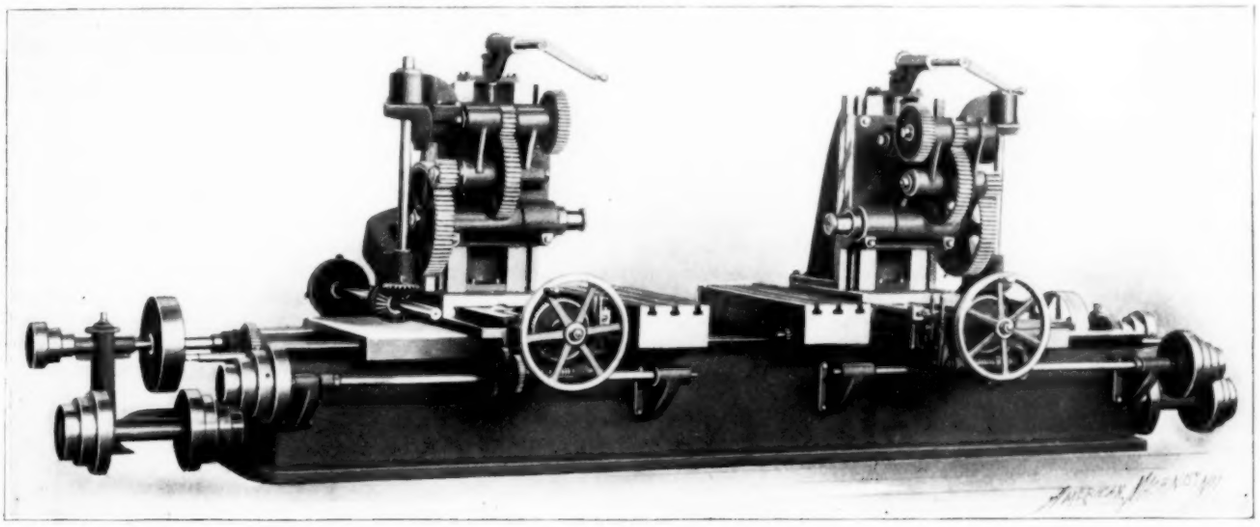


FIG. 1. DUPLEX MILLING MACHINE.

the columns have transverse movement, and the heads with the cutter spindles and driving gearing are movable up and down on the columns.

The spindles run in bronze boxes and are tapered at the nose to receive cutters; they are driven independently through two shafts at the back of the machine. As in this particular instance the machine is arranged for a Reeves drive, these shafts are fitted as shown with plain driving pulleys. Ordinarily, however, the shafts are provided with four-step cone pulleys—one of umns have independent feeds with automatic steps. With the ordinary countershaft the feeds obtained range from 1 to 6 inches per minute.

The gearing connecting the driving shafts and spindles is clearly shown in the illustrations, as is also the feeding mechanism for the columns. The feed rods, it will be noticed, are driven through cone pulleys at the ends of the bed, and each rod drives through spur gears a short shaft at the front, this shaft actuating by means of worm and worm wheel the column feed

The saddles are adjusted on the bed by means of screws operated by hand at the end of the bed; the tables are adjusted by screws attached to the saddles; the elevating screws for the heads are operated by handles at the front. The tables have working surfaces 12x32 inches. The greatest distance between the ends of the spindles is 6 feet 4 inches, and the least with both tables in place 32 inches; with one table removed the spindles may approach within 12 inches of each other. The maximum distances between spindle

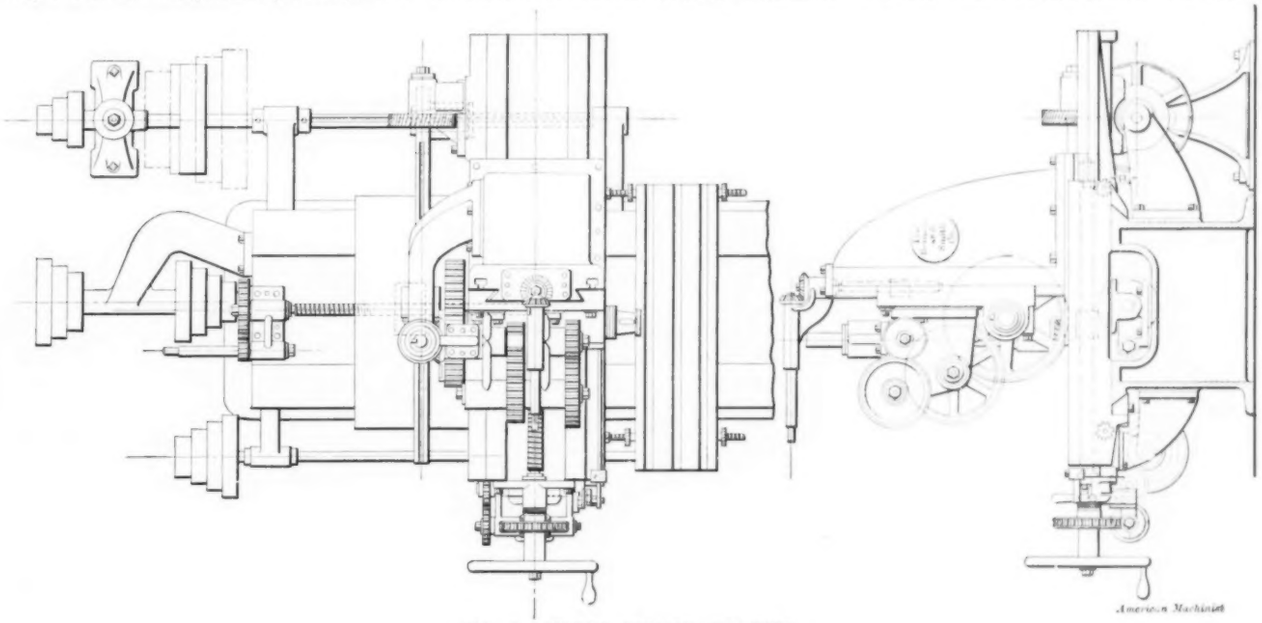


FIG. 2. DUPLEX MILLING MACHINE.

centers and the top of the table is 15 inches and the minimum 5 inches. The travel of the columns on the saddles by hand (through the hand wheels at the front) or by power is 36 inches. The countershaft has tight and loose pulleys 14 inches diameter for 5-inch belt. The machine weighs about 18,000 pounds. It is built by the Beaman & Smith Company, Providence, R. I.

A Work in Progress Record.

BY HORACE L. ARNOLD.

Having very lately written the entire forms of the C. B. Cottrell Sons Company, Westerly, R. I., for use in a forthcoming volume, and believing these forms to be admirably complete, inasmuch as they carry from 10,000 to 15,000 components in process of construction through the shop departments at all times without the slightest question, disorder or confusion, it was somewhat of a surprise to be confronted to-day, upon a return to the Cottrell shops, by a new and important record form, of such obvious necessity that it seems incredible that the need for it should have been keenly felt for years, without even an attempt towards the creation and placing in use of some record performing similar functions.

This "Work in Progress Record" form is precisely such a short-cut to ardently desired results as has been alluded to. All dates, weights and costs are elaborately kept on Cottrell forms which preceded this "Record" form, but remained in uncollected detail; the whole was available, but was in separated places, and was collected and summarized only in the mind of Charles P. Cottrell, general works manager of the shops, and he was often not quite sure of every historical detail of the work in progress, and was obliged to refer to varied sources of information and to carry records mentally, which should have been grouped together on a comprehensive form, so devised as to present complete records of the progress and termination of the order number, from the time of making the production order to the date of finished stores reception or order shipment.

This new form is in fact a ledger in which the history, not the costs, of the order is posted in sequence as the production events occur. It is purely historical, and does not deal with either labor, cost or factory location of components, and those three items form the peculiar field of factory forms records in general; so this "Record" is outside of the common functions of factory forms, and it is this unusualness of function, probably, which made the production of this form so late that Mr. Cottrell, in speaking of it, was led to say, "We have needed that form for ten years, and yet no one ever thought of it."

Something similar in effect is shown in the "Time Table" prepared for large engineering operations, but, so far as known, no other factory is now using an equivalent.

Two "Record" forms, A and B, are in use at the Cottrell works. These forms contain no material or labor spaces, and are used for purely historical records, and do not affect the costing in any way. The records shown are under column headings of printing press component names, but this form is capable of general application, and may be used for any production by making the column headings to suit the manufacture.

These forms A and B give full "Work in Progress Records," and are used to relieve the memory of the general manager from a part of its burdens, by tabulating on a Foundry and Purchase Record form, A, which is the first of the two Record forms used, the fact that the piece has been made and is held by the foundry ready for delivery to the machine shop; this record being made by the foundry foreman by a pencil cross at the left of the component column space, which is the simplest certification symbol known. Neither date nor weight is recorded, because those records are on other forms, and it would be work thrown away to write them on this form, which simply tells what components of an order in progress have been made in the foundry, and what have been ordered purchased and whether those pieces have been ordered into the machine shop or not.

PRESSES ORDERED IN FOUNDRY — DATE *Jan. 3—03*

10 "3 K Presses

Foun. No.	Constn No.	Cylinder	Side R.	Side L.	Base	Track	Bed	Table	Rocker Shaft	Fountain	Sliders	Feed Table Brk. R.	Feed Table Brk. L.
2000		X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X
2001		X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X
2002		X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X
2003	2000	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X
2004		X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X
2005		X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X
2006		X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X
2007		X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X
2008		X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X
2009		X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X
Cyl'r Cast	Presses Cast	Blue S.K.	Trans. Cards	Cyl'r Cast		Foun'n's Doctor		Brass Pipe					
X X	X X	X X	X X	X X		X X		X X					
												Made	X
												Ord. into Shop	XX

American Machinist

FORM A. WORK IN PROGRESS RECORD. CASTINGS, ORDERS AND PURCHASES.

The translation of the Foundry and Purchase Record, form A, is as follows:

"Presses ordered in foundry, January 3, 1903. 10 No. 3 K presses. The foundry numbers of these ten presses are 2000-2009, in sequence and inclusive, and the construction number against which all charges are written, is 2000." Two numbers have events recorded in a single space, one above the other to save room. This does not confuse the record at all. Continuing the record translation: "The cylinders, sides right, sides left, bases, tracks, beds, tables, rocker shafts, fountain, sliders, feed brackets right, feed brackets left, are made as shown by the left-hand pencil cross in each space. All of these castings have been ordered in work and sent into the machine shop, as shown by the right-hand pencil cross in each component space." So much for the information recorded by the symbols above the mid-line of column headings. This specified list of components does not include all the castings called for by the cryptogram "10 3 K presses," but only the larger pieces. There are five lines of spaces below the second line of column headings, and each of these lines may be used for two number records, thus making 10 record spaces available, as in the upper field of spaces.

This second line of column headings begins with cylinders. There is a large amount of work on the press cylinder; it may be wanted first in the machine shop, and if a cylinder belonging to an order not yet in work is sent alone into the machine shop, this unusual procedure should be noted on this historical record form. The foundry foreman has a production order for this construction, No. 2000, but has not yet put out any castings on that order. He is notified to produce the cylinder only, does so, certifies production by the left-hand pencil cross, and the production order clerk orders the cylinder into the machine shop by adding the right hand across in the cylinder space of foundry No. 2000, and also places two crosses in the cylinder space of the second row of column headings. Thus the cylinder may go to the finishers in advance of its usual sending, and in advance of all other components of the order number, without danger of duplication, as the foundry man is at once informed by his record card that the cylinder for No. 2000 was made and sent into the machine shop before he began on the remaining parts. "Presses cast" column records the finish-

ing of all the castings for press 2000. "Blue SK" is another addition to the Cottrell forms, and is made to meet the "Red line" list distinctions by changing the color of the "SK" card from green to blue.

"SK," which appears on these two forms, means "stock," and on the "Lists," which record the names and numbers of all components of one individual principal production, or machine, part numbers followed by "SK" are underlined in red and are kept in stock, in the stores room, in charge of the finished stores clerk, maximum and minimum, and are ordered by the stores keeper through the production order clerk for stores replenishments.

But a principal order calls also for these same components, which are made on "SK" orders, but *not* for the finished stores, as they are ordered specially for the principal production, and are to be sent by the transfer clerk to the "Waiting Stores," where all parts charged to any production order in work are sent as soon

PRESSES ORDERED INTO SHOP. DATE *Jan. 3–03*

10 3 K Presses

Form No.	Serial No.	Blue S.K.		Date	Cyl.		Built by	Store House		Shipped
2000	1900	X	X	*Jan. 11*			*Boulter*			*Feb. 26*
2001	1901	X	X							
2002	1902	X	X							
2003	1903	X	X							
2004	1904	X	X							
2005	1905	X	X							
2006	1906	X	X							
2007	1907	X	X							
2008	1908	X	X							
2009	1909	X	X							

American Machinist

FORM B. WORK IN PROGRESS RECORD. FINISHING AND STORES OR SHIPMENT.

as finished, to be stored until wanted on the erecting floor. It has been found both better and cheaper to provide a "Waiting Stores" room, in sole charge of a "Waiting Stores" clerk, who receives and delivers all components charged to principal order numbers, than to leave such components in the last operation department, where they are completed, until wanted for erection, as must be done if no special resting place is provided for such parts of a principal order as are finished in advance of erection requirements.

The "SK" parts are those demanding most work, besides being those which are kept in stock, and it often happens that identical "SK" parts are under construction in different lots at the same time, one lot charged to a stores room replenishment order number and the other lot charged to a principal production order number.

Formerly all "SK" orders, both for replenishments and principal constructions, were made on green cards, hence the color of the card did not specify the destination of the order, which might be either the General Finished Stores room or the Waiting Stores room.

Now the replenishment orders only are made on green "SK" cards, and the principal order "SK" parts are made on orders written on blue cards. This assists the transfer clerk, who knows that a blue "SK" order must be sent to the "Components Waiting" stores room upon completion, and must not be sent to finished stores, because it has been produced as part of a certain construction number and must be reserved to go to the assembling floor with the other components of that number. Two pencil crosses are filled in the "Blue SK" space by the production order clerk, one when he makes the "Blue SK" orders, which vary largely in number according to the form of press, but average about 50 "Blue SK" cards for each press, and the other when the production order clerk sends the "Blue SK" cards to the transfer clerk, which puts the "SK" components in work. The "Cylinder shafts" are hammered, not rolled, and are special for each order, as are the "Doctors," and the "Brass Pipe" for each order is also made a purchase, and not taken from stores; consequently, the production order clerk, who is virtually the private secretary and recorder and historian of the "head" or manager, should have a record of the purchase order made for this material, without having to look further than this record card form, which tells what castings are made, what of the larger castings are in work in the machine shop, what "SK" orders have been made and placed in work by sending them to the transfer clerk, and what the purchase agent has ordered in the way of special material.

As before said, all of this information is recorded in other places, but not all in one place; hence the great value of this record form and the peace of mind and tranquility of effort which immediately followed the introduction of this Record Form A, which deals with castings, making of orders and making of purchases for the order. When Record Form A is filled as shown, it certifies that the machine shop has all of the order materials in hand and is at work producing all the order components. Record Form B, filled as shown, decrees that 10 No. 3K presses shall be built, date of order January 3, 1903, bearing an order charge number as 2000, and that these presses shall have serial sales numbers from 1900 to 1909, inclusive, and that the "Blue SK" orders were made and sent to the transfer clerk January 11, 1903, and that the first one of these presses made on order 2000, and bearing the serial sales number 1900 was completed and shipped February 26, 1903.

The final dispositions of the remaining nine presses of the order will be recorded as events occur.

It is probably because this record form deals with events only, instead of with materials and labor, that its need should have been sorely felt for a long time before its conception and installation.

These forms are printed on stiff manilla cards, 6 inches long by 4 inches high, all in black.

Record cards A are used and handled as follows: Two forms are filled in duplicate, first two top columns only, by the production order clerk, and one is sent to the foundry foreman, who files it in his tray, and the other is filed by the production order clerk in a box on his desk, ready for instant reference. Once in two days the production order clerk goes to the foundry foreman's tray of Record Forms A, and makes his own duplicate agree with the castings produced record kept by the foundry. The card making and purchase records are made by the production order clerk.

Form B is filled and filed by the production order clerk at his desk. When the foundry man has made all the castings for an order and they are checked as transferred to the machine shop, the foundry man's form A is destroyed, as the duplicate record is held at the production order clerk's desk.

The "Cylinder" has two places for the same record. The first of these spaces, third column, top, form A, is "regular," and is the only one filled when the cylinder casting is not made in advance of the other castings. But the cylinders are often exceedingly intricate structures, and are therefore ordered in the machine shop long before the remainder of the castings are put in work, and in this case the irregular procedure is noted by the double record, the second one being made in the first column under the second line of headings on form A, because unusual procedure should always have an unusual record, sure to strike the eye at the first glance. Two hundred and fifty cylinders are in progress or on the Cottrell premises this

day, and the record of each should be known with absolute certainty, in full detail.

This record card cools and binds up more factory blisters than any other one kind of form previously met by the writer. Many attempts have been made to present part of the story recorded on these forms, with only partial success, and it is difficult to propose factory conditions under which this record card could fail to greatly facilitate production, and assure that tranquil frame of the managerial mind which is the first essential requirement of the successful factory.

New Universal Joint.

It is well known that where two shafts are connected by a single universal joint and with their axes inclined to each other, if one shaft is rotated at a uniform rate of speed the other will not rotate with a like uniform velocity, but will, instead, increase in speed during a portion of its rotation, this being followed by a corresponding decrease in rotative speed. To overcome this irregularity in the speed of the driven shaft, it is customary to place between the two shafts a third member, which is coupled to each shaft by a universal joint, this intermediate member then having an irregular velocity, but imparting to the driven shaft, so long as equiangularity between the axis of the intermediate and the axes of the two connecting shafts is maintained, a motion uniform and like that of the driving shaft, the irregularity created by the joint connecting the driver and intermediate being offset by the reversed conditions at the other joint.

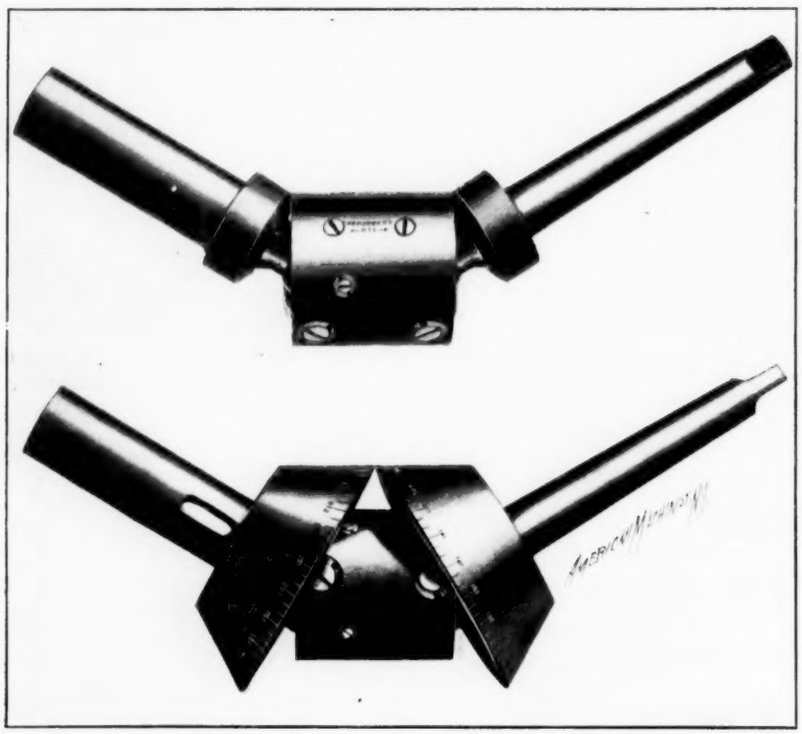


FIG. 2. UNIVERSAL JOINT.

In the accompanying engravings is illustrated a recently designed universal joint by means of which a shaft may be driven at a truly uniform velocity, the speed of the driven and driving shafts being alike at all points. The half-tone, Fig. 1, gives an excellent idea of the appearance of the joint, and Fig. 2 shows it as provided with two graduated collars by means of which practical proof is obtained that the two members connected by the joint rotate uniformly, the graduations on the disks always coinciding regardless of which shank is used on the driver. The construction of the joint will be clearly understood by referring to the line engraving, Fig. 3, which gives a partial sectional view through the body and through one of the shaft heads or sockets.

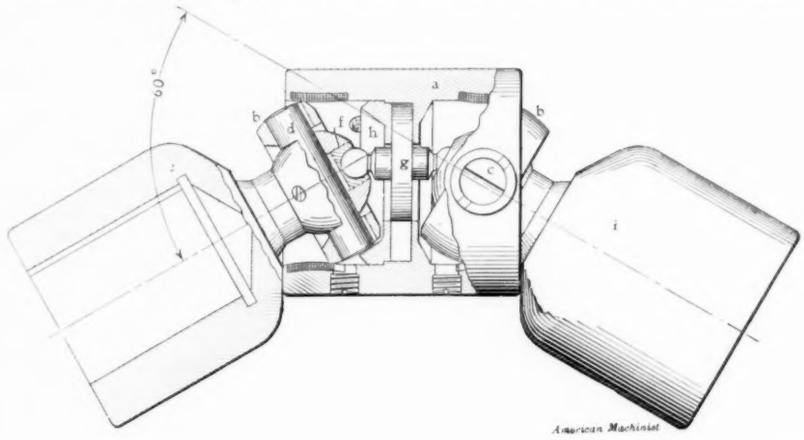


FIG. 3. UNIVERSAL JOINT.

The joint, it will be observed, is double; the body is in the form of a sleeve or shell, as shown at *a*, and at each end is a ring *b* carried by trunnion screws *c*. Through each ring passes a pin *d*, on which is pivoted a shaft head or socket, one of the rings and the head *e* being broken away to show this arrangement more clearly. Each head is drilled out and provided at its spherical end with a shoe *f*, which has a spherical seat for a ball end formed on the hub of a piece *g*. This part consists of a disk with the hubs as shown, which disk is placed in a disk-shaped recess formed between a wall in body *a* and a ring *h* which is held by screws against a shoulder in the bore. The disk is a sliding fit in the recess thus formed, and, the hubs being much smaller than the opening through the side walls of the recess, the disk can be moved freely in a plane perpendicular to the axis of the body *a*. Part *g* is called an "equalizer," it forming really an intermediate member and keeping both heads *e* and *i* inclined alike toward the axis of *a*. It will be seen that, no matter in what direction head *e* is moved, head *i* must immediately take a corresponding position on its own side of the joint, the axis of the hub of *g*, as this part is moved, always being parallel with the axis of *a*. Thus, as in all positions of either head or shaft, the other has a like inclination, the driven member will always rotate uniformly with the driver.

With this joint the driven shaft may be operated, as indicated in the drawing, at an angle of 60 degrees with the drive; that is, with one shaft fixed the other may be swung through an angle of 120 degrees. The various working parts of the joint are lubricated from oil chambers formed in the body, felt strips being provided, as shown, to retain the lubricant. Both trunnion and equalizer-ring screws are held securely in place by check nuts.

This very interesting and novel joint is the invention of H. D. Williams, of Washington, D. C., and is manufactured by the Waterbury Tool Company, Waterbury, Conn.

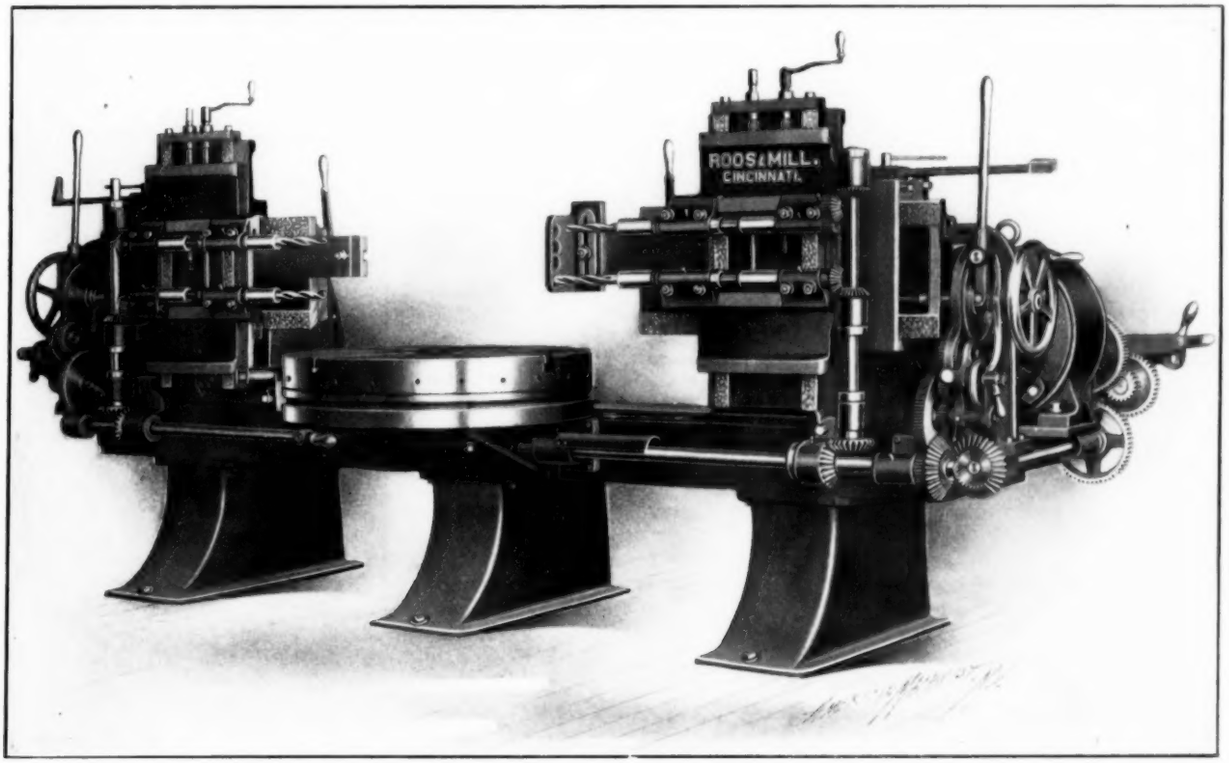
Four-Spindle Horizontal Drilling Machine.

We illustrate herewith a novel machine which, though designed especially for drilling and counterboring holes in motor yokes for field magnet fastenings, is obviously suited for a variety of other work as well.

This machine has, as shown, a round work table mounted on the bed, between two uprights, each of the latter having a cross rail carrying a saddle with two horizontal drill spindles. Each spindle is mounted in an independent head and each head is adjustable vertically by means of a screw in the saddle. The spindles have independent adjustments longitudinally to suit different lengths of drills. Stops are provided for automatically releasing the power feed at any desired point and by means of these, holes can be counterbored to the required depth. The drive is from a 4 horse-power Bullock variable-speed motor located at one end of the machine. The half-tone shows the method of mounting this motor, and also gives a clear idea of the arrangement of the mechanism through which the spindles are rotated and fed. The back gears with which the spindle drive is provided may be thrown in or out without stopping the machine.

The table is mounted on roller bearings to admit of its being readily rotated; it is provided at the periphery with index holes, and is locked by means of a spring pin; it has also a screw clamping device operated by the handle at the front. Each cross-rail carries an adjustable bar with a sliding head arranged to act as a guide plate for the drills, the plate being drilled to suit different spacings of holes in the motor yokes and provided with hardened steel bushings to accommodate different sizes of drills. The greatest distance that may be obtained between spindle centers is 12 inches; the least 2 inches, the longitudinal travel of the saddles is 18 inches.

Roos & Mill, of Cincinnati, Ohio, are the builders of this machine, the tool illustrated being made for the Bullock Electric Manufacturing Company, of the same city.



FOUR-SPINDLE HORIZONTAL DRILLING MACHINE.

The Future of the Steam Turbine.

An address by Dr. R. H. Thurston, Director of Sibley College, before the New York Electrical Society, March 18, upon "The Steam Turbine," was a valuable resumé of the history, development, present status and promise for the future of the steam turbine. This matter has come to the well-informed reader from so many sources that it is not necessary to attempt a recapitulation. All will be interested, however, in the speaker's estimate of the possibilities and the probable lines of future development of the steam turbine, and the following is therefore abstracted:

"The trend of progress and the promise for the immediate future is in the direction of further gain in economy of the machine by suppression of leakage and of friction of fluid within its casing by improved workmanship and by securing a better working substance by freeing it from water and also by utilizing the process of superheating to increase the thermodynamic range. This means, however, improvement at the boiler rather than at the engine; which latter is fitted in all its forms to employ superheated steam of any temperature that can be practically furnished from the steam-generator.

"The trend of progress at the moment is also toward the application of specially designed and constructed turbines to special uses. It is probable that, gradually, forms will be adapted particularly to use in electric light and power 'plants'; others will find employment as marine engines, and still others to other varieties of work. The regulation and the adjustment of speeds constitutes a problem, already satisfactorily solved in some cases, but which requires some further consideration in adaptation of satisfactory regulating mechanism to some special forms of turbine and to some special uses.

"The promise would seem at the moment to be the introduction very widely of a new type of prime mover which adapts itself in a peculiarly happy manner to purposes to which the common forms of steam engine are not likely to prove as perfectly satisfactory. The indications are that the supply of power by means of this motor will be made as low as with the best types of reciprocating engine and possibly lower; while its simplicity of plan and ease of construction would seem to insure freedom from liability to either accident or depreciation of value to any important extent for long periods of time. The theory and the practical modification of theory in the design, construction and use of the machine are so well understood and the

real so closely approaches the ideal that the engineer may readily see his way toward the solution of any practical problem of design that may be presented, while he also may as readily see a remedy for any observed defect of efficiency or of mechanical action. It should therefore be expected that such approximation to the ideal perfect machine as is possible will soon be attained; particularly as, already, the study of the theory and the observation of the practice of the time with this machine is now being made the task of an immense number of learned men of science, of able practitioners and of skillful constructors. Probably never, in the history of engineering, was so simple a machine made the object of investigation of so large a number of able men, inventors, constructors, engineers and men of science, and the subject of such extensive experimental research.

"It is very possible that, through the development of this ancient device we may yet see the nearest approximation to ideal thermodynamic and mechanical efficiency in the group of heat-motors that man can attain."

Automatic Feed for Embossing Press.

Some time ago I gave a description of the manner in which we make the different dies, etc., used in the manufacture of small medallions of various styles. To make the description complete, I now show what is an all-important part—that is, the automatic rack feed as made and used by us.

Fig. 1 gives a front view of the upper and lower bolsters with the dies in the act of embossing the blank; and shows stripping and sizing plates, a stripping lug and bracket (shown for one side only) and the ball-bearing attachment for operating the rack feed.

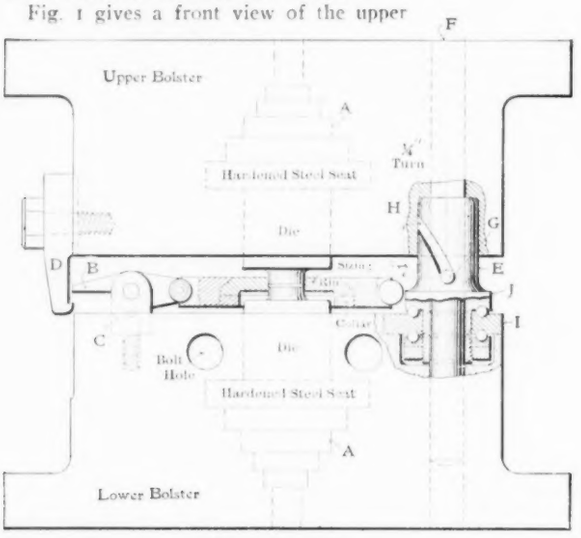


Fig. 1 Front View

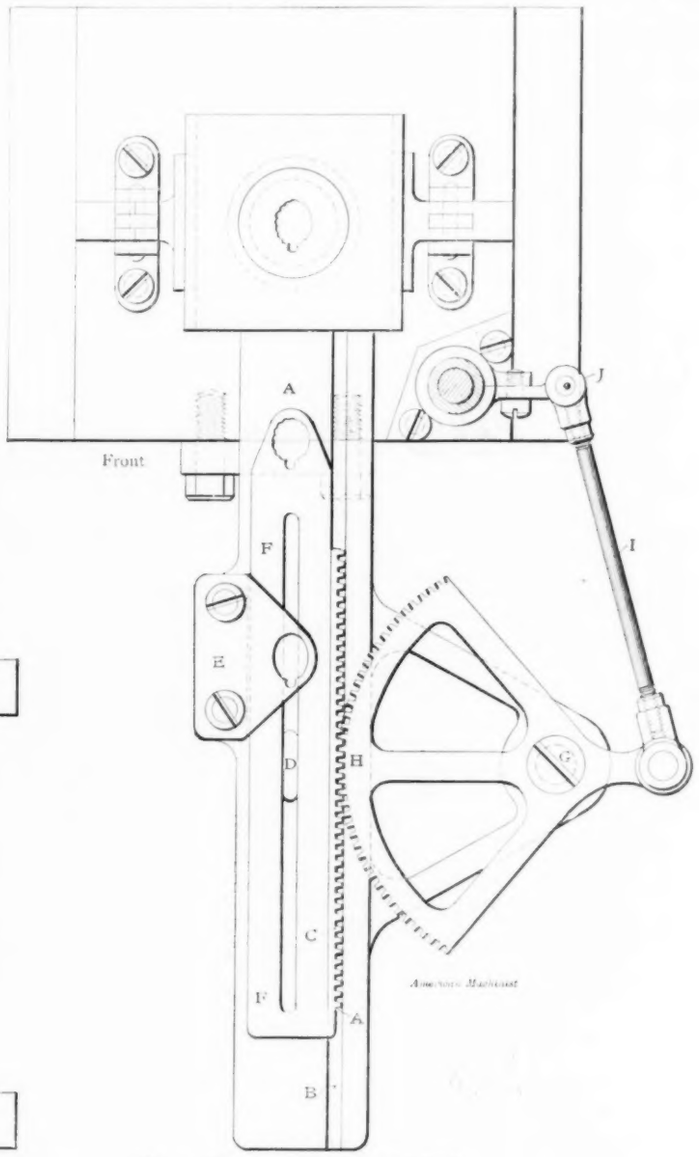


Fig. 2 Plan of Lower Bolster and Feed

AUTOMATIC FEED FOR EMBOSSING PRESS.

As you are aware, the action of the embossing press is different from that of the ordinary press, the lower die in the latter remaining stationary and the punch or die fastened to the ram moving downward, while in the embossing press the upper die is stationary and the lower die moves upward.

The bolsters, as explained before, are steel castings, machined as per sketch, and fitted with hardened and ground steel backings for the dies, as at *A*, these being firmly driven in from the face. The dies and the steel stripping and sizing plates have already been described.

The two stripping lugs, one of which is shown at *B*, are made in two pieces; they are tool-steel forgings and are held in bracket *C*—also of tool steel—which is let into the bolster and fastened with two countersunk screws. The two parts of each lug, which are made to fit together nicely, are connected with a spring on the outside, so that when coming in contact with the stripping dog *D*, on the upward movement of the press, the lug will open just far enough to slip by the dog and then spring back and be in the position shown when the press has reached the end of its upward stroke; on the downward movement the lug will catch on the inside edge of the dog and force the stripping and sizing plates down to the shoulder of the die, thus allowing the discharge of the embossed blank or medallion, which is accomplished, as explained before, by a sharp puff of air from a blower. The inner end of the lug is made to fit a groove in the stripping plate and is hardened. The extreme outside end where it comes in contact with the stripping dog is also hardened.

The sleeve *E*, for operating the feed attachment, is made of tool steel, bored slightly larger in the center so that the bearing will be for about ¾ inch at each end, and turned as shown. The lower shoulder is grooved for a ball bearing and the end is threaded 24 pitch for two adjustable collars, the upper one of which is provided with a ball race and hardened. A spiral groove *H*, wide enough to admit

the roller G in pin F, is then milled in the sleeve, the groove making about one-quarter turn in a distance of one inch, or whatever the full stroke of the press may be. After being hardened in whale oil, the sleeve is lapped to slide easily on the pin F (also hardened), which extends almost through both bolsters and is held in position by a set-screw (not shown) in the upper bolster.

The plate I is also made of tool steel and hardened; it is fastened to the bolster with two countersunk screws. Both sides of this plate are grooved for the balls J.

When we first made sleeve E we met with anything but satisfaction and tried nearly everything—fiber, etc.—to overcome the friction on plate I during the quarter turn necessary. After "busting" several plates we decided to try a ball bearing as an experiment, and this greatly surprised us by working without any hitch or accident.

Fig. 2 represents a top view of the lower bolster with everything attached, and shows the slide mechanism as it would appear when the press has completed about half of its upward stroke.

The bracket A is made of cast iron, and the top surface and the end where fastened to the bolster are planed. The groove B forms a guide for rack C and prevents undue friction or wear on the stop D (located just in the rear of the hopper E) which stop is so made that it may be dropped—by pressure on a spring lever on the under side of the bracket—below the surface of the bracket and so allow the easy removal of slide F, in case of accident, without having to disturb the hopper in any way. The bearing surface of the boss for segment H is milled off and drilled and tapped for a special large-head shoulder screw G on which H pivots. The bracket is fastened to the bolster with two cap screws, and has also two tapped holes for the screws which fasten the hopper in position.

The segment is made of brass, machined to the proper radius and cut 12 pitch. The end to which the connecting rod I is attached is fitted with a stud screwed in from beneath; this projects about ½ inch above the upper surface and the eye of the connecting rod is slipped over it, so that the segment can be easily uncoupled and adjusted without pulling the whole thing apart.

The split collar J, attached to the sleeve and forming the connecting link with the feed, can be adjusted on the sleeve and fastened in any position.

The feed plate and rack are made of brass. The plate is usually a trifle thinner than the blank and is riveted to the rack, which has a slot milled the full length to receive the plate, and bring the same just level with the surface of the bracket. The slot cut through the center and almost the full length of the plate regulates the extreme movement of the latter at both ends of the stroke, and is of great benefit in locating the hopper in the correct position.

The hopper is made of brass tubing of the same shape as the medallion, and is about 5 inches high over all. A slot, which is about ½ inch wide at the top (to expedite the filling with blanks to be embossed) gradually tapers down to the same size as the neck of the medallion to insure the blank dropping in the hole in the feed plate on the backward movement of the latter. This tube is soldered into a brass plate, about ⅛ inch thick, which in turn is soldered and riveted to what we call the "foot," also of brass, about ⅜ inch thick and fastened with two screws to the bracket.

All the operator has to do after the different parts are adjusted is to lock the treadle of the press and keep the hopper filled with blanks, these being constantly removed by the slide or feed plate. The action of the feed is governed by the groove in the sleeve E (Fig. 1) as follows:

On the first movement of the press, which, as explained before, is upward, the roller operating in the groove in the sleeve causes the sleeve and its split collar to turn toward the rear, the connecting rod I, Fig. 2, operating the segment and causing that to move the feed plate toward the hopper; and on the completion of the upward stroke—the roller then reaching the bottom of the groove in the sleeve—the hole in the feed plate is brought directly under the hopper and allows the blank to fall in. On the return movement of the press, everything then necessarily working the opposite way, the feed plate and blank are carried toward the die, and as the stroke is completed, the blank then being directly over the sizing plate, drops through on to the face of the die. The hole in the feed plate when the press is at rest is always in this position. During the upward movement and while the feed plate is being moved toward the hopper, the stripping lugs—as already described—slip by the dogs and spring back into position; and on the downward movement the dogs engage the ends of the lugs, the stripping and sizing plate is pressed down below the surface of the die, the blank is discharged as described and the stripping lugs and plate return to normal position, as in Fig. 1. Each individual part is so timed and adjusted as to work in harmony with the others, and when we finally reached this stage, after "hosts" of trouble, we decided that we had reached the limit.

A. C. R.

The largest overshot water wheel in the United States, that built by Henry Burden at Troy, N. Y., which has not been in use for forty years, and which few have seen, has lately been, and is now, exposed to the public gaze, in consequence of the dismantling of the building in which it is situated. The only larger wheel in the world is in the Isle of Man.

The Melting Ratio.*

BY JAMES A. MURPHY.

Many foundrymen have gotten into the habit of talking high melting ratios to such an extent that the more inexperienced proprietors are led to think that their foremen are simply robbing them, when 1 to 6 or 7 is the rule in their establishment. And yet a better ratio may be impossible to obtain when certain classes of work are to be gotten out properly. I do not believe in saving coke at the expense of castings, but this is just what many foundrymen are doing, and many more have done.

A few years ago I saw the efforts of the superintendent of a large Eastern foundry to melt at 1 to 10, with the natural failure that resulted for the particular class of work he had in hand. During two months of this trial, three steam cylinders weighing over 20 tons each, not to mention many tons of the smaller castings, were thrown out by the machine shop. All this work was lost because of dull iron. There were also many tons lost in the foundry which never passed the drop.

Now, there is no doubt at all that iron can be melted at the ratio of 1 to 10 *for certain kinds of castings*, and when anyone speaks of melting iron thus, it would be well to pin him down to facts—to ask him whether the coke and iron were accurately weighed; what the hight of his tuyeres is from the cupola bottom, the hight of charging door, diameter of cupola, and blast pressure; what percentage of pig iron, scrap or steel goes in; whether the pig and scrap were large or of normal sizes; whether coal was used with the coke, and the quality of each; finally, what was the class of work to be poured and the length of time necessary to accumulate enough metal to pour the pieces.

Information of this sort would be useful in making comparisons, even though conditions are seldom alike in any two foundries. One establishment may have a cupola of an improved type while the other would be struggling along with the old time home-made affair. I have on some occasions melted iron cheaper in the air furnace than in the cupola, but it would be folly to assert that the air furnace process is the cheapest. Extra good conditions governing a "heat" in the air furnace or cupola afford no criterion by which to judge or guide others.

Here is a heat of 16¼ tons taken off under pretty favorable conditions. The coke was excellent and the pig iron and scrap of normal size. In the first three charges there was 35 per cent. steel clippings; the other charges ran 50 per cent. pig and 50 per cent. scrap. Hight of tuyeres from under side of sand bottom, 14 inches; hight of charging door, 9 feet; pressure, 10 ounces; bed of coke, 700 pounds; first charge, 2,500 pounds iron and 200 pounds coke. Each succeeding charge had 2,000 pounds iron until the

* Journal of the American Foundrymen's Association.

last, when 100 pounds coke only were used. This was in the summer of 1901.

During the greater part of 1902 I could not melt a 10-ton heat better than 1 to 7 8-10, and smaller heats often down to 5¾. This was a great reduction from 1 to 9 as shown in the first example, but the quality of the fuel was responsible for this. Had I kept up my melting ratio, I would have lost many castings, and as these were engine and other particular castings, they had to be sound and perfect in every detail.

I am a firm advocate of economy in our foundries, but believe that in many instances the saving of fuel to give higher melting ratios is equivalent to saving a gill at the spigot to lose a gallon at the bung-hole.

Making a Herring-Bone Pinion Pattern.

BY G. F. DODGE.

In the office where I am employed, a drawing was made some time ago for a 15-tooth 40-inch diameter herring-bone pinion for a roll train. Having spent some little time in the pattern shop, I found myself wondering just how I would attempt the job of making the pattern if it were to fall to my lot but came to no definite conclusion, never having seen anything of the kind made.

The method here presented was devised by Fred Peutecke, the patternmaker who did the work and who has furnished the details.

Fig. 1 shows the finished pinion, the original drawing of which gave the angle of the helix at the pitch line of the tooth, as also at the root, and the tooth outline.

Fig. 2 shows the completed pattern in part section. The crown of the pattern was built up of segments, as shown, with a recessed parting line at the center, and turned one inch smaller in diameter than the root diameter of the pinion. The necks at each end were recessed into the crown, which insured the alinement of the completed pattern. *B B* are lifting eyes for the halves of the crown, and *C C* are hardwood stiffening strips screwed to the inside of the pattern.

Fig. 3 shows the method of fitting the teeth to the crown. The block *D*, of such dimensions as to contain the outline of the tooth (shown in dotted lines) was gotten out to the exact half length of the pattern and placed in the box, where it was held by the thumb-screw and the points of the two screws at the bottom, while the back was cut to the correct radius on the bandsaw. The edges *E* of the blanks were then carefully laid out and finished by hand.

Fig. 4 shows the most interesting operation of the whole job, viz., that of forming the outline of the tooth along its winding length. *F* represents the face-plate of the pattern lathe with two fly cutters securely bolted to it. *H* is a segment of an equal crown bolted to the adjustable angle plate *J*, which was in turn bolted to the lathe bed, the crown *H* being adjustable vertically by means of the slots *K K*. Upon this crown were fastened the guide strips *L L* so as to just fit the edges *E E* of the blanks, Fig. 3, and hold them just as they would set on the half crown of the pattern.

With this arrangement it was then only necessary that the tooth outline be carefully laid out on the ends of a tooth and this tooth placed in the guides, adjusting the angle plate and crown segment so that the cutters just came to the outline and clamping tightly. All teeth for that half of the pattern then had a cut taken along them by feeding them along the guide strips past the cutters when a readjustment was made and another cut taken. The whole outline of the tooth was thus finished so close to form that a slight application of sandpaper made a first-class job. The teeth were then screwed to the crown and the spaces between filled in with strips of the right thickness.

It was found after the job was completed that over two weeks' time had been saved by fitting up as per Fig. 4, as it took less than two days to make the fixtures and finish the teeth ready to screw in place.

Fig. 5 shows a sectional view of the completed mold before drawing the pattern. All such pinions are made of open-hearth steel and molded in a similar manner, the flasks being circular in form with an enlargement along one side to accommodate the runner.

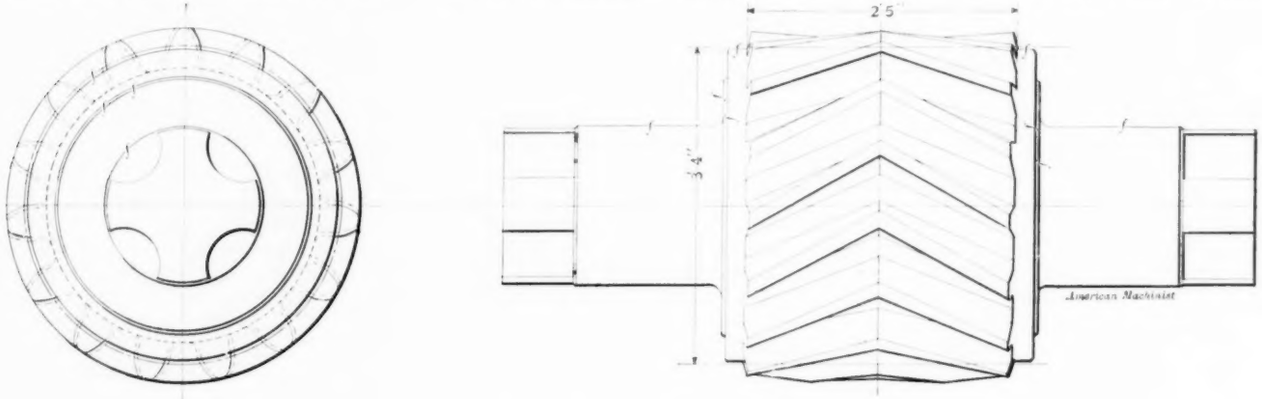


FIG. 1. THE GEAR TO BE MADE.

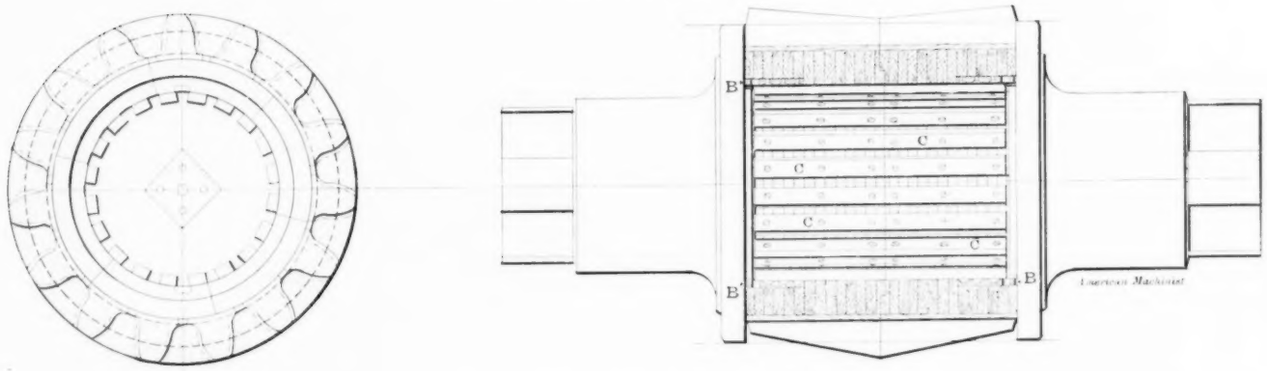


FIG. 2. CONSTRUCTION OF THE PATTERN.

Accident Due to Combustion in an Air Compressor Cylinder.*

BY ALBERT R. LEDOUX.

I propose to describe a somewhat uncommon casualty resulting from a not infrequent incident in the use of air compressors. The compressor in question was a "three-drill" machine of standard make. At the time of the accident it was furnishing air to a single drill working in an upraise from a well-ventilated tunnel, giving ventilation to a winze below the tunnel where two men were hand-drilling. The compressor also furnished power to a small hoist in the winze, but the hoist was only operated occasionally, and never while the drills were working. The drills were located about 1,200 feet from the compressor. The engineer testified that he never had been short of air, and that there had been no complaints that the machine was inefficient. The engineer testified further that the water used in cooling the air cylinder had never become greatly heated, but that he used a mixture of good cylinder oil and of a lighter grade known as "Atlantic Red." The valve of the compressor was set to blow off at 80 pounds. He was eating his luncheon in the boiler-room when he heard a "crack like a pistol," and going into the engine-room found water spurting out of the jacket about 2 feet from the end of the compressor; he tightened the jacket and stopped the leak, and found that the jacket was perfectly cool. He next noticed that "grease" began to fry on the pipe and receiver.

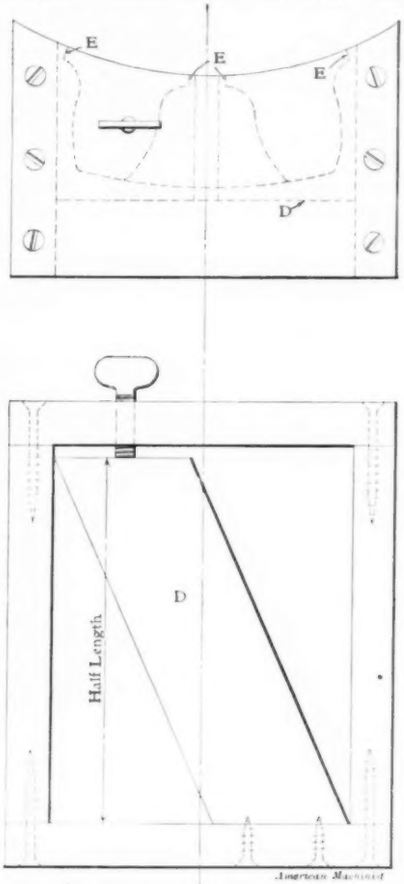


FIG. 3. JIG FOR SAWING SEAT ON CROWN.

He next saw that the air pipe had become red hot, the heat extending to a point where the pipe went through a wooden partition, setting fire to it. Then he noticed that the pressure was going down "just as quick as if someone had opened a valve outside," which, in fact, is what had been done. He stopped the engine, but, getting the signal for more air, started up again. It is well to note at this point that the intake of the compressor was in the engine room, the temperature of which usually stood at 115 degrees Fahr.

Let us now see what occurred in the mine. What happened at the bottom of the winze cannot be better told than in the testimony of one of the miners at the coroner's inquest: "I was turning a hole and my partner was turning the drill. He says, 'We ain't got much air here this morning; I will ring for some more air.' He rang, started to strike again, and struck two or three blows; straightened up and took a couple of breaths of air, and started in to strike again, and then quit. I had been joshing him, and says, 'You ain't as tough as you used to be.' I stood up, picked up a pick, struck two or three blows, and felt that the air was bad. Just then the air stopped, and the hoist tender hollered to us that there was no air, and we had better come up. I looked around and seen my partner standing in the corner. He was all trembling, and I caught him as he fell over."

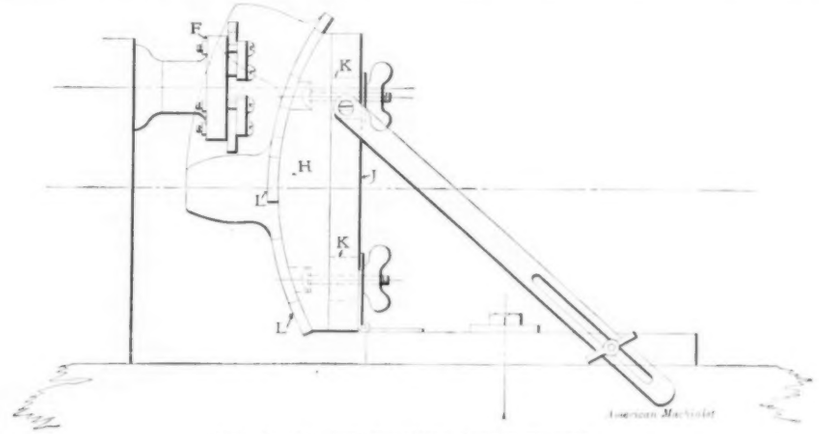


FIG. 4. JIG FOR FORMING TOOTH PROFILE.

These two men were gotten up by heroic work on the part of comrades, and their lives were saved. But not so fortunate were the men in the upraise. There were four of them there, and when they felt the air getting bad they opened the valve full, of course only increasing the difficulty. They were experienced miners, and at first could not understand what was the matter with them, because their candles continued to burn as usual. This was due, undoubtedly, to the fact that they were working in an upraise, and that the heavy carbonic acid gas sank, and perhaps to the fact that carbonic oxide may have been generated through incomplete combustion or the reduction of the carbonic acid, first formed, by the glowing carbon in the pipe.

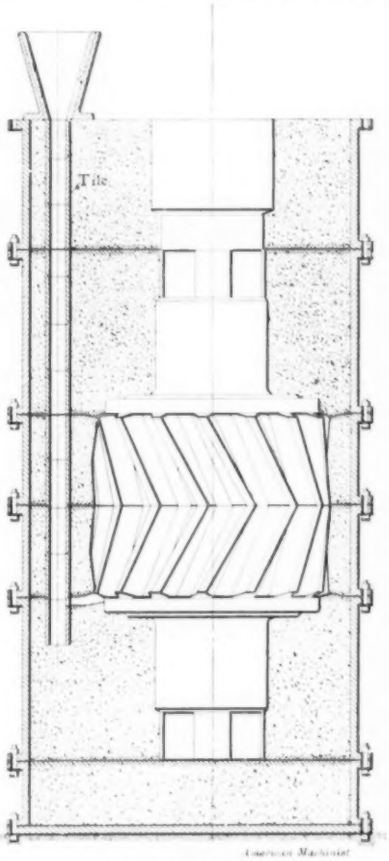


FIG. 5. THE PATTERN IN THE MOLD.

Two men were killed and four others barely escaped with their lives, as a result of the combustion of the oil, deposited carbon and organic dust accumulated in the compressor, receiver and pipe. Explosions of air compressors due to this cause have been frequent, and lives have been lost thereby; and what is known as the "flaming" of compressors or cylinders is an every-day experience, and in some cases the rupture of the air pipes, but so far as I can ascertain, without the serious consequences described in the present case.

* From a paper read at the Albany meeting of the American Institute of Mining Engineers.

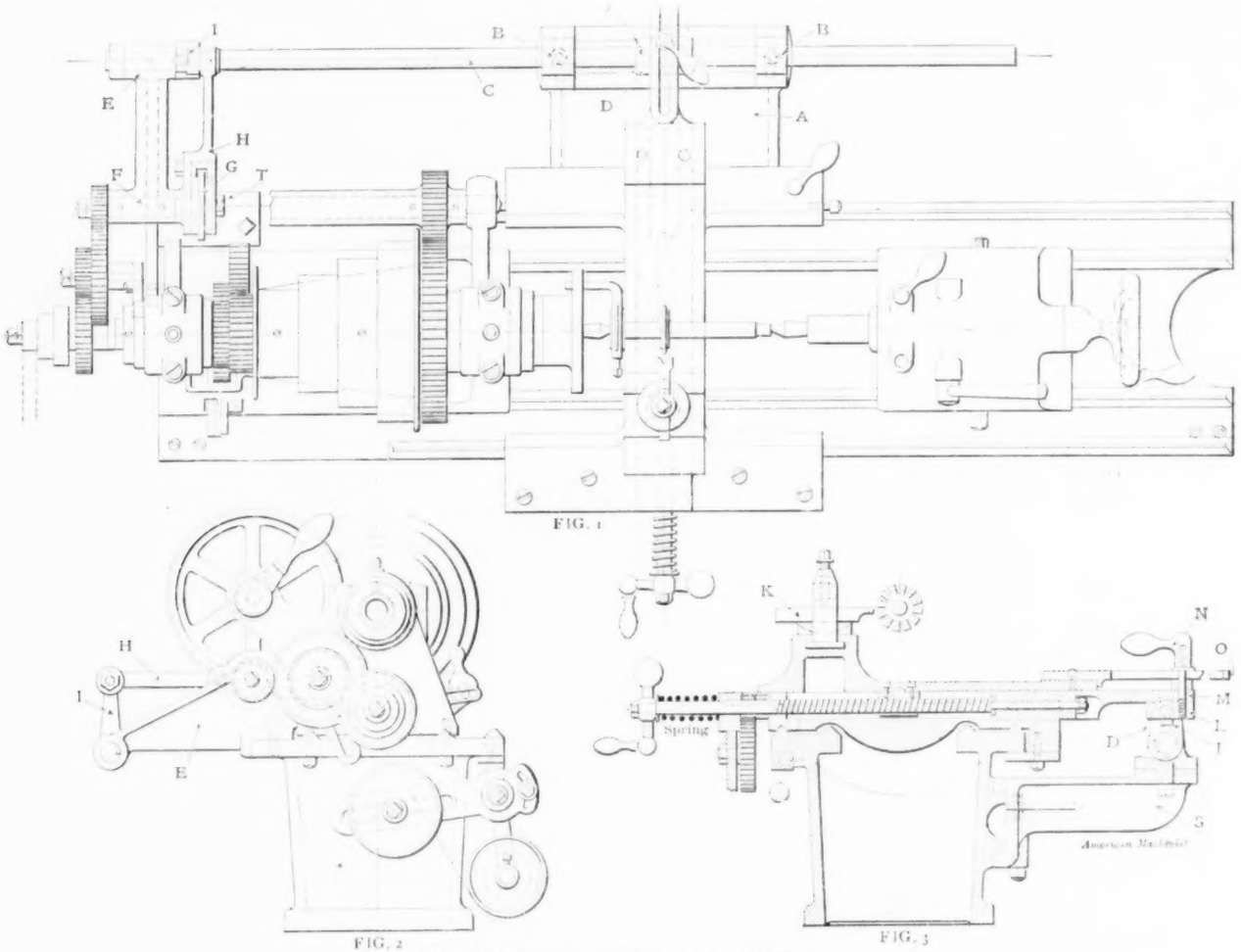
Backing-Off Attachment for the Lathe.

BY WM. RUNGE.

This attachment is intended for relieving or backing off the teeth of formed cutters, hobs, taps, etc., and is fitted to a lathe having a taper turning attachment. Fig. 1 is a plan of the lathe with the taper attachment slide removed. Mounted on the slide support *A* is a bracket *B* with a bearing at each end through which passes a splined rod *C* which is adapted to rock in its bearings. The distance between the bearings *B* allows the slotted arm *D* and the carriage of the lathe sufficient travel without loosening support *A* at the back of the bed, and also admits of any length of arbor being used that will go between the lathe centers. As will be seen, the splined rod *C* continues into bearing *E*, which is fastened, back of the headstock, to the lathe bed, the back gear being broken away in the drawing to show the fastening of the bracket. The same bracket also supports cam shaft *F* on the outer end of which is shown the gearing for operating the cam *G*. This cam is adjustable and may be changed from 0 up to 5-16 inch, giving any clearance up to 5-32 inch, on the cutter teeth—the tool being operated by the short arm *D*. Fig. 1 also shows the connecting rod *H* which is attached to the upper end of the long rocker arm *I*, giving a powerful leverage to the shorter arm *D* between the bearings *B*. Fig. 3 is a cross-section of the carriage, bed and taper attachment support *A*, and also shows arm *D* which is milled through the upper end for the bolt *J* to allow the necessary movement as the tool *K* is moved in and out. The bolt is held in place with a bearing *L* on the under side of the shoe piece *M*; *L* is held in place with the regular stud and binder *N* used on the taper attachment. The shoe piece *M* also belongs to the taper attachment. By tightening *N* the slotted piece *O* at the back end of the tool block is clamped to *M*. The tension may be gaged to suit the operator. For straight feed relieving such as taps and hobs, the handle may be bound tight. It will be seen that the cross-feed screw passes back through piece *M* and is held in place with a nut; the screw then extends forward through the tool-block nut and the front of the carriage, and between the handle at the end and the carriage is placed a spring which takes all the backlash out of the working parts of the relieving attachment and also pulls the tool away from the cutter with a quick movement.

Fig. 4 shows in detail the adjustable cam, connecting rod, etc., and, as will be seen, the cam has four teeth. *P* is a plate keyed fast to the cam shaft and provided with four slots—one of which is shown—to which are fitted the four adjustable cam teeth or plates *Q*, each of these having a tongue on its inner face which slides in one of the slots. In front of each plate *Q* is milled a groove crosswise of the tongue on the back face. A plate *R* is placed in front of the cam; this plate has four holes in which are four pins having flat heads fitting in the slots in the faces of *Q*. As the plate *R* is turned to the right or left the parts *Q* are adjusted to suit the operator. Next comes a plate *S* which is keyed to keep it from turning; after the proper adjustment has been made—plate *R* being turned by means of a pin in the holes in the periphery of the plate—the nut *T* (Fig. 1) is tightened and all parts of the cam are held firmly.

The connecting rod *U* has an oblong hole at the large end which allows it to travel back and forth over the hub at the back of plate *P*, without vertical movement. The rod is provided at *V* with a bumper and at *W* with a bolt. As the teeth of the cam pass and feed the tool in the spring in front of the carriage compresses, and as the teeth slip off of bolt *W* the spring pulls the tool out of the work



LATHE ARRANGED FOR BACKING OFF CUTTERS.

and the bumper V strikes against the outer edge of plates P, R and S. The cam surfaces are hard, as is also the bolt. The inner surface of the latter is made to suit the curve of the cams; and the bolt may be turned in its socket to suit the cams as these are adjusted. The top of the bolt is made flat to allow the cam teeth to slip off quickly.

Fig. 2 is an end view of the headstock showing the arrangement of the gearing, bracket, etc. In making the cam the plates were all milled and drilled on the dividing head; the cam plates or teeth were then milled to fit and pins were turned and their flat sides milled. The parts were then put together and turned on the outer edge, the teeth being turned the same diameter as the plates. This attachment takes the regular change gears of the lathe, and will, by compounding the gears, relieve cutters having from 1 to 32 teeth. As will be seen, the cam is true; and the spring on the cross-feed screw being at the front of the carriage, all backlash is taken out and the tool takes hold of the tooth of the cutter or hob instantly.

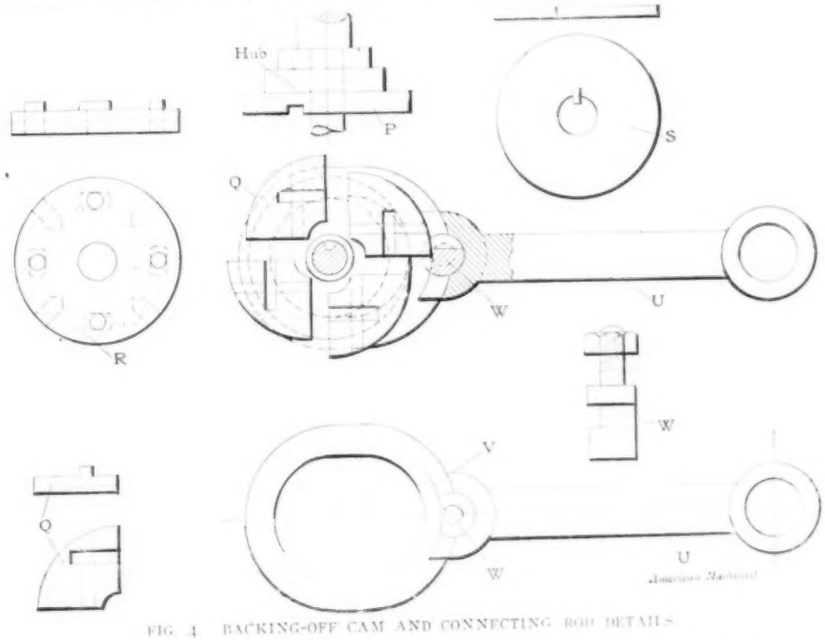


FIG. 4. BACKING-OFF CAM AND CONNECTING ROD DETAILS.

The Engineer's Foundations.

We have gained a store of knowledge about materials, energy and organic life, and have organized it in such a way that it seems to point to a few great, generalized facts. We apparently have learned that Nature is never idle, but that she is a persistent worker with a steady, cumulative activity in which there is ever a unity and no discontinuity; that there is an ever-present dovetailedness, as Dickens, I think, put it. Nature's activities are not isolated and independent of each other, but are apparently all in intimate relation, and governed by the same all-providing fundamental laws. This is the foundation on which the engineers of the present century have to work. Meagre as it is, it is far in advance of that occupied by their predecessors of one century ago.

Of fundamental laws we seem to have proved two—the law of the conservation of energy, as it is called, and the law of organic evolution, which controls the development of life through "the survival of the fittest." The Law of Conservation of Energy asserts that energy cannot be created or destroyed. We may transform energy in any manner within the compass of our intellect, but we finish with the same amount of energy as we started with. We may transform the chemical energy of coal, by combustion in a boiler furnace, into heat energy, and this may be utilized to "raise steam." The energy in the steam may be transformed into mechanical energy by means of a steam engine, and this into electrical energy by a dynamo. The electrical energy will be less than the original chemical energy because some of the heat has gone to contribute warmth to the surrounding air and solid bodies, but the available electrical energy added to all of this heat (which has not been destroyed, mind you, but continues to exist as heat) makes a sum which exactly equals the original chemical energy in the coal.

Another fundamental law has been ordinarily accepted as governing. This relates to matter. You all know that matter is apparently indestructible. Transform it as we may; change, by combination, the matter which we call hydrogen and that which we call oxygen into that which we call water; again, combine this with metallic sodium to form caustic soda; again, form other combinations or compounds;— but through them all we have apparently transformed matter without gain or loss, and hold the same mass at the end of our transformation as we held at the beginning. The chemists have been making a very thorough study of this idea for years past, and they do not seem convinced that it represents a universally applicable law; but for all present purposes of the engineer it may be safely accepted.

In accordance with these laws relating to matter, energy and life, and their myriad of corollaries, the professional engineer must carry on his work through the discovery of scientific principles and their useful combinations. Invention is no longer a mere question of designing a working machine. That may now be safely left to the skilled mechanic; while the engineering inventor must discover new combinations of scientific principles and give them applications that are useful to man in order that they may more perfectly contribute to the support of the race. Men must be educated for this purpose in our Schools of Applied Science. This education cannot be efficiently gained without the help of the schools.

Again, new principles must be discovered and great laws deduced, and contributions must be levied from them for the support and advancement of the race. It has long and justly been regarded a signal achievement to discover an important phenomenon or principle in science, and the discoverer has been stamped a learned and great man. It is still a signal achievement to discover, but the discoverer may add lustre to his fame in our time by directing the application of his discovery to the service of mankind, so that no undue delay may be suffered to occur before it too contributes to the welfare of civilization. These men also may be most effectively educated in our Schools of Applied Science.

The motive force of progress and civilization at the opening of the twentieth century is infinitely greater than at the opening of the nineteenth, largely due to discoveries and the world's slight education in science; and the possibilities following great discoveries are equally increased. Carrying this education of the people in applied science to its farthest must accentuate the progress, bringing with it those trains of good that follow in the wake of broader intelligence and wider opportunities. Every industry, every line of transportation or system of intercommunication, every branch of useful endeavor, has profited by the growth of scientific teaching and the work of the engineering schools; and civilization, which spreads, fattens and grows great through transportation and intercommunication between peoples, has been the gainer. Manifestly, the influence of the Schools of Applied Science is vastly greater than the effect directly produced on their individual pupils—large though the latter is.—*Prof. Dugald C. Jackson, at the Quadro-Centennial Celebration of the University of Colorado.*

A steel casting weighing 85,000 pounds was recently made by the Penn Steel Casting Company, Chester, Pa. It was a hydraulic cylinder for a car-wheel press for the Baldwin Locomotive Works.

Weight of Flywheels for Engines Driving Direct Connected Alternators.

BY A. M. LEVIN.

The determination of the proper weight of flywheels for engines direct connected to alternating current generators, is an undertaking which, conducted according to the customary methods, is rather time-wasting.

The necessity that alternators, working in parallel, should rotate with a nearly perfect synchronism, demands a regulation of the engine, not based on the variation in speed, but based on the maximum distance a pole may be allowed to deviate from the position it at the time would occupy, if running with perfectly uniform speed.

In order to get an estimate of this displacement, it has been considered necessary to lay out graphically the changes from uniform rotation to which the wheel is subjected, but a few of these speed curves and displacement curves, as they are generally called, will convince us that the same class of engines, for different steam pressures, powers and within certain limits also for different speeds, give very similar curves. It therefore suggests itself that if we have at hand one curve for each type of engine, in which we are interested, then we have all the information which is necessary to settle the question of displacement for any engine of similar type.

This consideration leads us soon to utilize the curves only for the determination of certain constants pertaining to different types of engines which, worked into some more or less approximate formula, will give a fair answer.*

Another circumstance, which will also soon be noticed, is that by assuming just a little later cut-off in one end of the cylinder than in the other, we can manipulate things so as to make the curve look very much like anything we wish, and we will then tumble to the fact that we are here up against a condition as well as a theory. For, however absolutely correct the theory may be, we must remember that the curve is simply a geometrical construction, built on certain assumed conditions, while the engine may work under quite different conditions, depending on the adjustment of its gear.

A formula which approximates to the same result as the laboriously delined curves give is not less reliable, and as it is often imperative on the designer to be able to form a reliable opinion at short notice, it is certainly preferable. That such a formula is based on pure theory is, however, desirable, and it is most important that all the approximations which have been made are thoroughly understood. In using it then we are in a position to supply our good judgment in the matter, and are able to arrive at a more conclusive result.

The object in the following is to derive such a formula from well-established theory, supplemented by a few approximations, which conform to a number of carefully plotted displacement curves.

A set of the curves referred to is shown in the diagram, curve *I* being the effort curve, *II* the velocity curve and *III* the displacement curve. Each one of the lower curves has been obtained by integrating the one above it. The abscissæ represent time, and the entire length of the diagram represents the time for one revolution.

We know that it is the maximum accelerating work, represented by the shaded area below the effort curve which causes the flywheel, and the revolving masses in general, to increase their velocity from a minimum to a maximum point, and if we also know what part this area is of the total work done by the engine throughout one revolution, then we can easily find the extreme fluctuation in velocity by the known expression:

$$V_{max.} - V_{min.} = \frac{C \psi H.P.}{R N^2 W} \qquad (1)$$

in which

$V_{max.} - V_{min.}$ = the change in velocity, in feet per second, of a certain point of the wheel at a distance R from the axis;

N = number of turns per minute;

$H.P.$ = horse-power at the point of cut-off at which ψ has been determined;

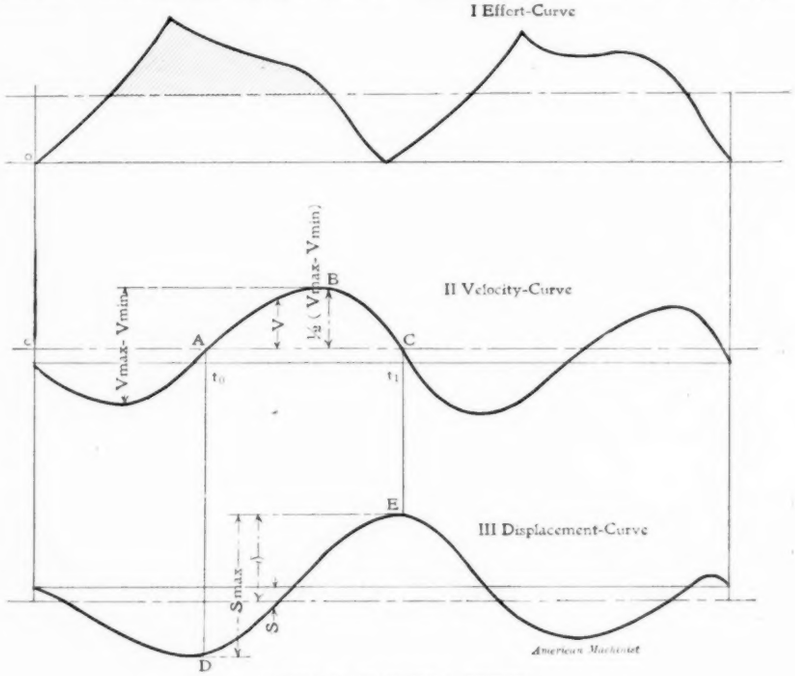
W = weight of the revolving masses reduced to the radius R;

C = a constant $\frac{33{,}000 \cdot g \cdot 60}{2\pi}$ = 10,000,000, approximately;

$\psi = \frac{\text{area of accelerating energy}}{\text{area of total energy}}$ called coefficient of maximum fluctuation of energy.

ψ for single engines and tandems = 0.12 to 0.16; for cross-compound engines = 0.05 to 0.14. The only approximation that has been made in this formula is the assumption that $V_{max} + V_{min.} = 2 \times$ mean velocity of the point in consideration. This quantity $V_{max.} - V_{min.}$ is represented in the diagram by the vertical distance from hill to hollow of the velocity curve.

Before going further it may be well to remember that the displacement curve represents, by its ordinates, the distance which a pole of the generator, or any point of the revolving system, is ahead or behind the position it would have gained at the time with perfectly uniform velocity.



CURVES OF FLYWHEEL EFFECTS.

Point *D*, following a period of low velocity, is a minimum point—the pole there being a maximum distance behind, and point *E*, following a period of high velocity, is a maximum point, where the pole is a maximum distance ahead of the position due to uniform velocity.

Any ordinate S of the displacement curve is such that

$$S = \int v \, dt.$$

The area *A B C*, we will say, is the largest area of high velocity. Therefore we have:

$$S_{max.} = \int_{t_0}^{t_1} v \, dt$$

In order to get a definite expression for the distance $S_{max.}$, it is now necessary to make some approximations in regard to the area *A B C*.

* The handiest way to do this is to determine the coefficient for the scale of the curve, with the supposition that the curve was laid out for an engine of one horse-power making one revolution per minute, and having a wheel of one foot radius. Having this coefficient, we can, by multiplying and dividing it by the various factors, get the result directly

First, we assume that the curve defining this area is parabolic. By studying the curves for different engines we may be convinced that this assumption will not lead us far astray.

Secondly, we assume that the time t_0 to t_1 is one-third of the time for one revolution. This allowance is in some cases excessive, but if any difference in effort exists between the head end and crank end of the cylinder, or with the reciprocating parts unbalanced, as in vertical engines, it can easily even exceed this amount. (Single engines and tandems give, as a rule, curves showing a shorter interval of time between highest and lowest velocity than cross-compound engines.)

The third supposition we make is that

$$\delta = \tfrac{3}{5} S_{max.}$$

That is, we assume that the wheel deviates three-fifths of the total distance $S_{max.}$ towards one side of the position of uniform speed, and two-fifths towards the other.

With these assumptions we get the equation:

$$S_{max.} = \tfrac{2}{3} [\tfrac{1}{2} (V_{max.} - V_{min.})] \cdot \tfrac{1}{3} \cdot \frac{60}{N} = \frac{1}{9} \frac{60}{N}$$

and for the maximum deviation of the pole from the position of uniform speed we get:

$$\delta = \frac{4}{N} (V_{max.} - V_{min.}).$$

Which equation combined with (1)

gives $$\delta = \frac{4}{N^3} \frac{C \psi \ H.\text{-}P.}{R \ W}$$

or $$W = \frac{4}{N^3} \frac{C \psi \ H.\text{-}P.}{R \ \delta} \qquad (2)$$

This equation determines the weight required at a radius R to keep the maximum deviation at that point inside the limit δ feet.

For the sake of comparison, we now quote the recognized formula for the moment of inertia required in a wheel, to keep the *fluctuation of velocity* inside a certain limit. It is:

$$W R^2 = \frac{96{,}400{,}000 \ \psi \ H.\text{-}P.}{N^3 K}$$

where K is the coefficient of fluctuation, which is chosen generally at 1-30, 1-50, 1-100, 1-200, depending on the nature of the work which the engine is to do.

The moment of inertia required in a wheel to keep the maximum deviation from the position of uniform speed inside a certain limit δ, we get from equation (2)

$$W R^2 = \frac{40{,}000{,}000 \ \psi \ H.\text{-}P. \ R}{N^3 \delta}$$

δ is here a certain length in feet measured at the distance R from the center. Also

$$W R^2 = \frac{2{,}300{,}000{,}000 \ \psi \ H.\text{-}P.}{N^3 \gamma}$$

where γ is the angle of deviation or

$$W R^2 = \frac{1{,}150{,}000{,}000 \ \psi \ H.\text{-}P. \ P}{N^3 E}$$

where E is the allowed fluctuation in degrees phase and P the number of poles in the generator.

This last formula is the most useful in connection with electrical work, where the requirement as to steadiness depends on the number of poles in the generator.

The results that these formulas give depend now largely on what horse-power we rate the engine at, as also on the choice of the coefficient ψ. As it is necessary, however, that the regulation should be satisfactory even at a partial overload, it is well to rate the power corresponding to a somewhat late cut-off, and to select the coefficient from the higher figures given above rather than from the lower ones.

As Others See Us.

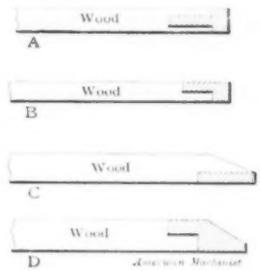
At a meeting of the Yorkshire College Engineering Society, . . . Mr. R. J. Sloan, an old student, related his experiences in the United States, where he had stayed twelve months in order to obtain an insight into the methods in use in American engineering works. According to the lecturer, the best equipped machine-tool shops are found in the New England States. Most of the new shops used electricity at the time of his visit, but some had what he called a barbarous custom of employing naked arc lights, which greatly dazzled the eye. Comparing the shops of this country with those of America, he asserted that the worst shop he ever saw was in the States. Speaking on the question of masters and men, he said that an American master might start at 7 in the morning, but he leveled up the day by taking it pretty easy in the afternoon. The American manager, or superintendent, as they called him, engaged all the men employed and sent them to the foreman, who could discharge a man at his discretion. It was not considered necessary to have been brought up as an engineer to become a manager. One shop he came across was managed by a man who had been a barber in Leeds. Foremen were more numerous in American shops than here—one to about every fifteen men—and they drove them a trifle harder. The American workmen boasted much of their independence, and looked upon British workmen as something on a level with Russian serfs; but Mr. Sloan saw few evidences of independence among American workers. Their average hours were about 59 per week. Trades unionism was strongest in the West; in Chicago it was very strong. In some of the Eastern States it was very weak. One gang he encountered had a Norwegian foreman, and among them were a Dutchman, a Swede, an Irishman, a Frenchman, a German, and men of several other nationalities, and consequently there was no cohesion among them; each regarded the other as a foreigner. In conclusion, the lecturer compared American and British tools, and he advised all young engineers to pay a similar visit to his own to the States. In a discussion which followed, Professor Goodman said that half the shops in Leeds had now got American tools.—*The Engineer.*

Letters From Practical Men.

Cements for Celluloid.

Editor American Machinist:

A reader of the AMERICAN MACHINIST asks for a cement that will attach wood and celluloid to the edges of draftsmen's triangles and T-squares and for methods of affixing the same. The following cements which I have used have given good results. The first, known as xylonite solution, is composed of shreds of celluloid dissolved with ether, and can be obtained from the British Xylonite Works, Hale End, Chingford, England. It can be used for sticking celluloid to wood, also two pieces of celluloid together, so that if properly cemented, it is not possible to part them. Great care must be taken that the surfaces or edges have no greasy substances on them; and, to insure against this, it will be best to thoroughly clean them with a piece of glass paper before painting the solution on. A camel's-hair brush will be most suitable for this purpose. After the solution has been applied, the pieces must be firmly clamped together and remain until thoroughly set. This solution must be kept from the air, as the ether evaporates and the solution dries up.



JOINTING CELLULOID TO WOOD.

The second cement is called seccotine, and this will stick anything, such as wood, iron, delft, paper, pasteboard, cork, leather, felt, cloth, glass, ivory, ebony, vulcanite, bone, celluloid, etc., and it can be obtained from the manufacturers, McCaw, Stevenson & Orr, Linenhall Works, Belfast, Ireland. I have used this for cementing felt and pasteboard, celluloid and wood, vulcanite and wood, and various other substances. The directions will be the same as for the first, only where possible the articles can be slightly warmed. I am sending a sample of wood and celluloid united with each of these cements. I should propose to make a tongued joint if possible like *A*, or a lapped and butted joint like *B*. *C* and *D* may answer for either T-squares or triangles.

E. J. TOWNDROW.

Leytonstone, Essex, England.

[The sample sent by our correspondent is a thin piece of wood covered with thin celluloid on each side. The cementing of each seems to be absolutely perfect, and there is apparently nothing to choose between them, except that the seccotine shows

the least color through the celluloid. Neither conceals the grain of the wood.—Ed.]

The Action of Iron and Steel Under Different Degrees of Heat.

Editor American Machinist:

To begin with, I wish to agree with Mr. Haley, at page 99, Vol. 26, on two points: First, I do not dispute the statements of Mr. Wilmore, at page 1849, Vol. 25; second, it is not only possible but a very easy matter to twist square iron and steel uniformly.

I designed a machine for twisting square iron bars which twisted iron bars ranging in size from ⅜ inch square by 12 feet long to 1¼ inches square by 28 feet long (the larger sizes 1 turn in 3 inches) their entire length excepting a couple of inches on each end where they were held in the chuck and vise, and the twist of every bar was perfectly uniform. I do not suppose each turn was correct within 1-64 inch if measured with a scale, but to the eye no unevenness was perceptible.

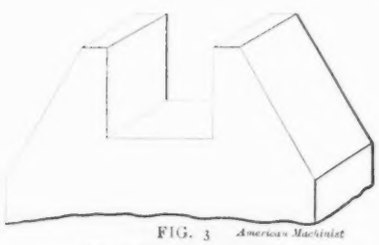


FIG. 3 American Machinist

TWISTING SQUARE BARS.

The bars were twisted *cold*. You can see, of course, the difficulties the uniform heating of such long bars would involve, particularly as they were twisted by a contractor of concrete flooring, etc., who lacked the facilities of heating, on account of which lack heating was not even thought of. He is, however, twisting hundreds of *cold* bars uniformly, daily, without any difficulty, and with considerable profit.

It was found necessary, however, to use a good grade of material, in which the grain ran evenly. A cheap grade of iron was tried, but was found so full of hard spots as to render its use impracticable.

There is no difficulty in twisting a good, even grained, grade of iron or steel uniformly if twisted *cold*, and I am sure (with Mr. Haley) there will be no difficulty in twisting hot, provided they are heated uniformly. I believe greater success will be attained by twisting cold, even in short bars.

The bars above mentioned were used to serve the same purpose as hair in plaster, being imbedded in concrete flooring to prevent cracking, the twist holding the cement together much better than the straight bars. It was also found that the twisting toughened the bars considerably.

The machine is shown in Figs. 1 and 2.

Upon the completion of the machine I witnessed the twisting of several bars, and, strange as it seemed, the length, over all, of the bar was precisely the same after twisting as before.

The conclusion we reached, as the reason for the seeming phenomenon, was that the corners of the bar simply stretched around the center, the position of the metal in the center, running the entire length of the bar, remaining unchanged.

The bar was firmly held on one end

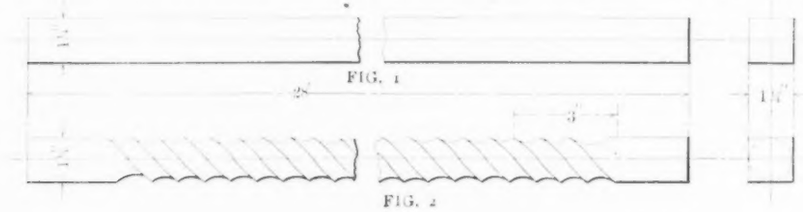


FIG. 1

FIG. 2

only, which was held in a chuck designed for the purpose. The other end lay in a block having a square opening, Fig. 3, and was not fastened in any way

C. H. RAMSEY.

High Speed Lathes.

Editor American Machinist:

Since the advent of the Taylor-White tool steel, mechanical engineers all over the world have been devoting a lot of attention to heavy cutting at speeds which up to that time had been thought impossible. They, by their experiments, tests, etc., soon found that the order of things had been completely reversed, so that now the capacity of a machine is the utmost possible output that the *machine* can negotiate, and not, as it hitherto had been, the capacity of the cutting tool. In other words, it is now the tool and not the machine that is the master.

A few manufacturers, who have desired to be in the front of the procession, have designed special machine tools suitable for the high speeds and heavy cuts which have been made possible by the introduction of the new tool steel, while others have modified their regular line as a sort of compromise; and it is the writer's firm opinion that English makers have been the keenest in this matter, so far as making entirely new designs go. For the last two years nearly every mechanical paper published has given considerable space to descriptions of different makes of tool steels with accounts of their performances (which in some cases are remarkable), but it is very seldom that the machine tools on which these results were obtained are mentioned, and therefore it may be both interesting and instructive to consider briefly the design of High Speed Lathes (this is the name given to them in this country) in comparison with the ordinary common or "garden" type.

Lathes have been chosen for this article because they are continuous in their action and not intermittent, like the planer, shaper, slotter, etc., which machines, besides having to have some special device to absorb the momentum before the reversal takes place, are usually working cast iron, and this metal cannot, even by the use of the new tool steels, be cut at as comparatively high speeds as can wrought iron, machinery steel, etc. This was found to be the case in this country; the scale and the varying degrees of hardness of the castings not allowing the great increase of speed that is possible on forgings, shafting, etc., which are generally of a more uniform quality. An incident which came under my notice a short time ago will serve to illustrate this: A traveler for high-speed tool steel (of a well-known make) called at a certain shop and asked to demonstrate the qualities of tools made from their steel. He was given the use of the blacksmith's fire and a hard cast-iron pulley and told to go ahead. After hardening and grinding the tool he proceeded to try and turn up the face of the pulley, but failed miserably, apologetically remarking that the metal was too hard, but when the foreman turner turned it up, using Mushet steel, the traveler left rather hurriedly without stopping to shake hands.

The first and most self-evident alteration that will have to be made in the lathe design is of course the increasing of the driving power; and for data it may be as well to give the results of a test made by me some time ago. The machine was a 9-inch center (18 inches swing) lathe, having a cone 13, 10½, 8 and 5½ inches diameters for a belt 3 inches wide; the countershaft speed was 140 turns per minute. The following are the particulars of the cuts taken from forgings of 30 tons tensile strength:

	Reduced	Feed per rev.	Cutting Speed per min	Metal Removed per hour.
(1)	3 1/16″ to 3 3/8″	1/8″	30′	253 lbs.
(2)	3 3/4″ to 3 5/8″	1/12″	180′	202 "
(3)	3 5/8″ to 2 3/4″	1/24″	30′	118 "
(4)	6 1/8″ to 5 3/8″	1/12″	50′	96 "

In the European supplement of the AMERICAN MACHINIST for May 31, 1902, is illustrated a very powerful 12-inch center lathe by the German Niles Tool Works Company. It was stated that this machine reduced a shaft of 30 tons tensile strength from 14¾ to 13 13/16 inches diameter, with a feed of ¼ inch and at a cutting speed of 40 feet per minute; the weight of metal removed by this

cut is approximately 1,000 pounds per hour.

Another firm (English) give the following performances of their 12-inch center high-speed lathe operating on a 5¾-inch diameter hammered steel bar of 32 tons tensile strength:

	Reduced	Feed per rev.	Cutting Speed per min.	Metal Removed per hour.
(5)	5¾″ to 5⅝″	⅛″	205′	330 lbs.
(6)	5¾″ to 5½″	¼″	80′	540 "
(7)	5¾″ to 4½″	⅛″	80′	1,300 "

Now this last cut (7), as stated, removes about 1,300 pounds of metal per hour, is undoubtedly the best of the lot, and is about five times as big as the best on the 9-inch lathe (1); therefore it is safe to assume that five times the belt power will be required to pull the cut. This may be obtained by making the cone 26, 21, 16 and 11 inch diameters, 4¼ inches wide and using a double-thickness belt (it is assumed that a double belt is 1.7 as strong as a single belt, and the one used in the writer's experiments was a ¼-inch thick single belt).

The back gear will have to be increased in strength to meet the extra pressure coming on it from the above cone. The feed gearing also must be made stronger, as the feeds usually used in this kind of work are coarse and heavy.

The bearings will have to have increased surfaces, and in my opinion this should be got by increasing the length rather than by making the diameters abnormally large; increasing the diameters increases the losses by friction, but adding to the length makes no difference whatever to the frictional losses. Some increase in diameter will of course be necessary, as the twisting moments in most of the shafts will be greater, while the greater vibration set up by the faster speeds and heavier duty also points to an increase in diameter, but it must be remembered that the strength of a shaft varies as the cube of the diameter, so that doubling its diameter makes it eight times as strong, and therefore very little increase in diameter is really necessary for the sake of strength: again, if the diameter be doubled, the losses by friction are doubled, the periphery speed is doubled, and the difficulty of providing efficient lubrication is doubled. I have been informed that one firm who make high-speed lathes had trouble with their machines because the live spindle bearings got hot and seized, and it is "dollars to doughnuts" that better results would have been obtained with bearings less in diameter, the bearings being about one and a half times as large in diameter as they would put on an ordinary lathe.

The bed will need to be of greater depth and well supported, and if the machine is going to work long periods chewing off 1,300 pounds of metal per hour it will almost be necessary to attach a conveyor belt to carry away the turnings.

The carriage will need to have a good support directly under the tool, and it will also be necessary to provide a pump and connections for lubricating the tool.

Another point which will give some trouble and which will allow designers some scope for their abilities is the tailstock; the dead spindle should have some means to allow for the expansion of the piece being turned. Assuming that a shaft 20 feet long was being turned up its full length, and its temperature was brought up to 200 degrees Fahr. by the operation (which is easily possible at the high speeds used) the expansion due to this change of temperature would be nearly half an inch—a rather serious matter, of course. The dead spindle could be turned back by hand this amount as the cut advanced, but this is rather a primitive way of evading the difficulty.

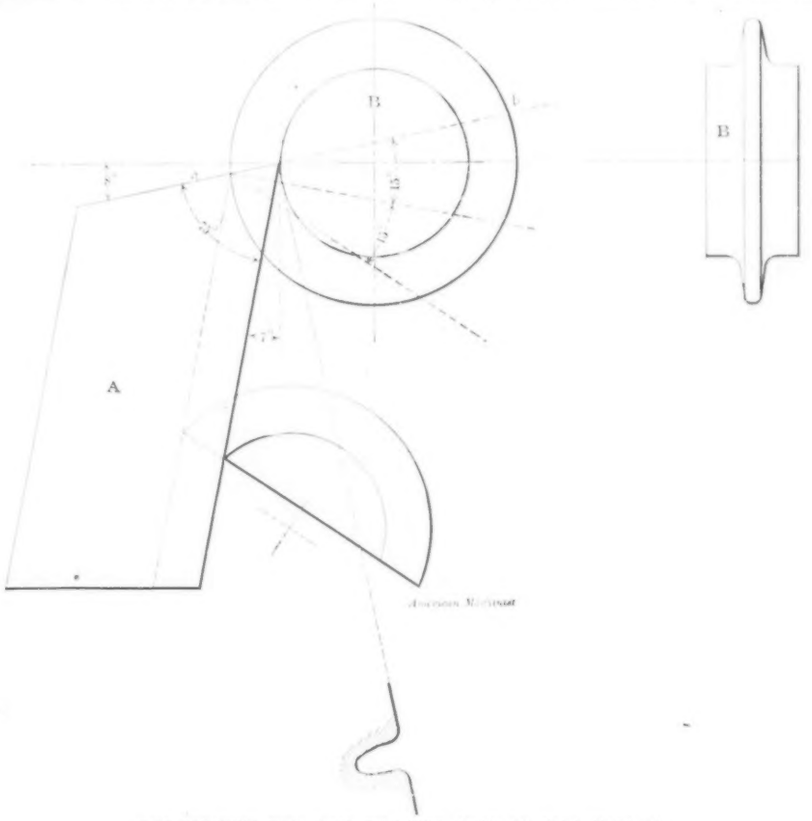
In my opinion high-speed cutting is a great step in the forward direction, and the design of machine tools suitable for its adoption is both important and interesting. As before mentioned, nearly all the talking and printing on this subject has been, up to the present, about the tool steel, while comparatively little has been written concerning the machines themselves. Now that Taylor-White, Speedient, Novo, Express and a host of other brands have had their way it is about time machine tools had a turn, and I hope that others may come forward and give their experiences with the machines and let the tool steels have a much-needed rest.

England. A. LATHER.

Making a Correct Forming Tool.

Editor American Machinist:

Some time ago we got an order for a forming tool for a turned piece, shaped as shown in the sketch at *B*. The customer wished to have the angle of rake 8 degrees and the angle of clearance 7 degrees. It is obvious that the shape of section of piece *B*, on line *a b*, differs from that on the diameter of the same body. The arcs become elliptic, the straight lines joining them become curved, and the whole length is shorter. We solved the question perfectly and yet in a very simple manner. We turned the body *B* out of tool steel to the exact size. We divided this into two parts by a cut along the line *a b*, hardened the smaller part and used it as a scraping tool for making the finished cut on the derived forming tool, using a shaper. Of course this scraping tool was fixed, as shown in the sketch, within an angle of 75 degrees to the horizontal line of stroke of machine. The result was a very satisfactory one. OTTO ECKELT.



THE FORMING TOOL AND THE TOOL USED IN FINISHING IT.

Berlin, Germany.

Losing Time.

Editor American Machinist:

What supervisor or foreman has not been a party to a dialogue like this: "Another quarter this morning, Tom." "Yes, sir; overslept myself, I s'pose. Have to get that alarum geared up a bit, or not go to sleep at all."

On the face of it and if not used too often, the "overslept myself" formula is a plausible one and answers the purpose

of squaring the boss; but when Tom's lathe isn't making any chips for the first 2½ hours three times in a week and a certain job either doesn't get done to time or another man has to run Tom's lathe to finish it, it becomes a matter of urgent importance. It isn't every shop of small or medium size that could with impunity tell Tom to pack up and clear out. His place may be filled with as bad a timekeeper or a worse workman. Besides, it might have cost you quite a pile to shape him into the all-round man he is—a sort that, about here anyway, is mighty scarce. Sacking a man is only scotching the evil in any case, as a skilled mechanic will easily get another job and hold it until his weakness becomes evident and intolerable. Perhaps too little stress is laid on this point by foremen and others in engaging men.

Bad timekeeping is without doubt one of the most demoralizing influences in a shop and carries with it the most disastrous consequences to the proprietor. Spread over a period of twenty years, we have tried every recipe that came at all near to common sense or expediency. We have endeavored to inculcate discipline in this respect by means of force and by means of persuasion, by bonuses and by fines, by altering the starting time from 6 A. M. to 7, by refusing admittance after proper time; but all to no purpose, every effort appearing a mere waste of energy. Usually the best workmen and those of longest standing are the worst offenders. A few years ago we made a selection of some of the worst timekeepers and replaced them as opportunity presented with new men, but at the end of six months the temporary improvement had quite vanished.

A year ago we started a scheme on which we built great hopes. I give below an outline of the rules for the perusal of those of your readers to whom such may be new.

RULES FOR "QUARTER-CLUB" FUND.

(1) A committee to be elected annually by the employees, consisting of three or more members and a treasurer.

(2) The employer agrees to pay to the fund 2d. per week for each hand who does not lose any time during the week.

(3) Payments to the fund by time losers to be as follows:

	For loss of a quarter of a day	For loss of any less time
Workmen in receipt of 25s. and over	3d.	1d.
Workmen in receipt of between 15s. and 25s.	2d.	1d.
Workmen in receipt of under 15s.	1d.	½d.

(4) The total amount of the funds derived from the contributions of employees and employer to be divided twice a year among *all hands* at such times as may be determined by the committee in the above proportion, namely, 3d., 2d. and 1d.

(5) All lost time to be determined from the time-book. In case of illness or any other sufficient cause for absence, a notice stating such cause must be sent during the day, failing which the matter will be dealt with by the committee.

(6) In the case of workmen leaving from any cause, the question of remission of amounts paid in shall be determined by the majority of the shop, but in no case shall such remission exceed one-half the amount paid in.

(7) Employees not returning to work at the fixed time after holidays will become subject to rule 3, unless special arrangements have been made beforehand.

(8) In the case of men working late at night the following exceptions will be made: (a) Those working until 10 P. M. will not be liable for stoppage up to 7 A. M. next morning. (b) Those working after 10 P. M. will not be liable for stoppage up to 9 A. M. next morning.

(9) In the case of an employee who has not worked the full year, his share shall be determined *pro rata* to time worked.

(10) All disputes to be referred to the committee for settlement.

As will be seen, the effect is to automatically penalize the bad time-keepers to the advantage of the good ones. It has at least the merit of being—to use the expression of one of the sufferers—"rather constant" in its action. Every default is visited by a fine.

I am sorry to say that after a full year's experience of this "Quarter Club," even that appears to be waning in its influence. The confirmed late-comer has learned, or has become resigned to look upon it as an inevitable fixed charge upon his wages, like rates and taxes. On comparing notes with other folk, I find most, or I may say all, in the same hole. The big fellow with his thousand hands may say: "Oh, we don't stand any humbug; no bad timekeepers our way"; but for all that I am convinced that in this country the slackness of workmen in this matter is a pressing evil, the extent and far-reaching effects of which on the trade as a whole are not sufficiently realized. Lost time is bad for the workman and is bad in a double sense for the employer, for not only are his profits diminished by decreased production, but his establishment expenses per man are increased in direct proportion. The bad effect on the morale of the shop in general, and on juniors and apprentices in particular, are items of no small importance.

The evil consequences will, I think, be readily granted, as also, I believe, the wide prevalence of the disorder. Could the causes be so easily diagnosed we should probably be a long way on the road to the discovery of a remedy. Are mechanics so well paid that they can afford to lose time? Is 6 o'clock, or even 7, too early to expect men to commence work? Do they drink too much or go to bed too late at night? If the cold mornings are a difficulty in the winter, why do they lose just as much time in the summer? Is a more reliable aid to waking at the proper time required? Is the lack of self-discipline and strength of mind increasing? JUNIOR BOSS.

England.

An Oil Pump Experience.

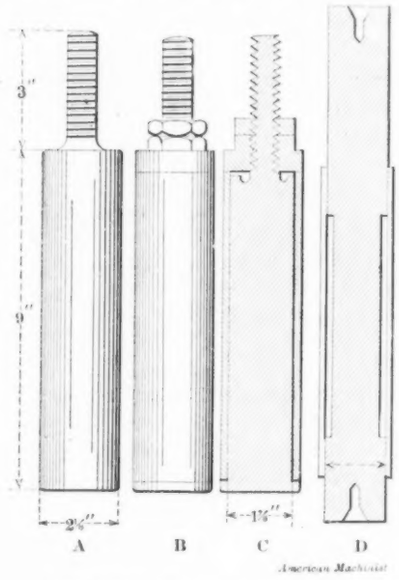
Editor American Machinist:

While I was a mold maker at a large glass bottle factory, things other than making molds sometimes fell to my lot as the following experience will show. A fuel oil plant is used for firing the small reheating furnaces, known in the glass business as "glory holes," and there is a small continuous glass melting furnace. The oil is supplied to the burners under pressure, and it is blown through them into the furnaces in a fine spray by compressed air at about 11 pounds pressure. The oil is drawn from a small service tank by a two-cylinder, single-acting, flywheel, plunger pump, the discharge from which passes, under an air chamber, through a coil heated by the exhaust steam of the pump to the factory supply pipe. On this pipe near the pump is a connection to a stand pipe. This connection may be closed by a valve. The stand pipe is 2½ inches and is jacketed by a 4-inch pipe carrying the exhaust from the air compressor which supplies air for this system. Supported within and somewhat shorter than the stand pipe is a 1¼-inch pipe open at the top. The lower end of this 1¼-inch pipe is led back to the service tank. It will be understood that the excess of oil above factory requirements passes up the stand pipe and overflows through the 1¼-inch pipe into the tank. The overflow is thus heated that it may keep the oil in the tank warm enough to flow freely in cold weather. The stand pipe should be kept overflowing to keep the pressure constant.

About sixteen months ago the factory manager came to the mold shop and reported that the burners were not working and directed us to locate the cause of the trouble and apply a remedy. An examination showed that the pressure gage at the oil pump (which should show a pressure of 22 pounds when the stand pipe overflows) was fluctuating between 10 and 16 pounds. As the valves, both suction and discharge, clicked as if working properly, I went to the tank expecting to find the oil low, and was surprised to find the tank full and the overflow running a good stream. Here was a puzzle: the stand pipe overflowing at less than half the theoretical and usual pressure necessary to lift the oil to the overflow. The connection between the factory pipe and the stand pipe was then throttled and the pressure promptly rose. It was temporarily controlled by throttling the stand-pipe connection. Now, why should the stand pipe overflow under these conditions? Two solutions offered themselves: One was that the overflow had a large leak below the top, the other that the steam jacket had overheated the oil in the stand pipe

and it had boiled over. The frothy nature of the oil overflowing strengthened the latter theory. The compressor was stopped as soon as possible without interfering with factory operations, and while the oil pump was kept running the stand-pipe connection was opened. The pressure stood at 22 pounds, proving there was no leak. We now have a three-way cock in the exhaust pipe from the compressor and in warm weather the exhaust is turned out of the stand-pipe jacket.

The drawings will show how we renew the plungers of this pump. The plungers



RENEWING OIL PUMP PLUNGERS.

were originally as shown at *A*. They were turned to receive sleeves of drawn steel tubing and threaded for the clamping arrangements as shown at *B* and *C*. The tubing was turned to size and faced on both ends on the arbor shown. The sleeves are kept on hand, but are more durable than either the solid machinery steel or brass plungers used before. While taking two or three minutes longer to put on than a solid plunger, the arrangement has the advantage of lower first cost, greater durability and keeping the plunger to a constant size, thus saving packing.

WM. A. FRANK.

The Metric System in Germany.

Editor American Machinist:

With reference to Mr. Ball's article, the "Metric System in Spain," at page 526, I would like to state that while I was working in Germany as a machinist, up to '96, I always used rules with metric markings only, and they were of German make, and I could get them in any old hardware store, as far as I can remember.

In Germany all the important screws and nuts are not entirely dimensioned after the English measurements. For instance, the diameter of the inscribed circle of the hexagon, that is, the width of the wrench, is 1.4 d. + 5 mm. All the twist drills I ever saw in German machine shops were sized to the millimeter. If I wanted to drill a tap-hole, I had to ask for a drill of so many millimeters. So that the only way the inch affects the German machinist is that he ought to know that the inch is 25.4 mm., and, except for thread cutting, it would not bother him if that inch were a mile long. Any German engineering pocket-book will tell the tale.

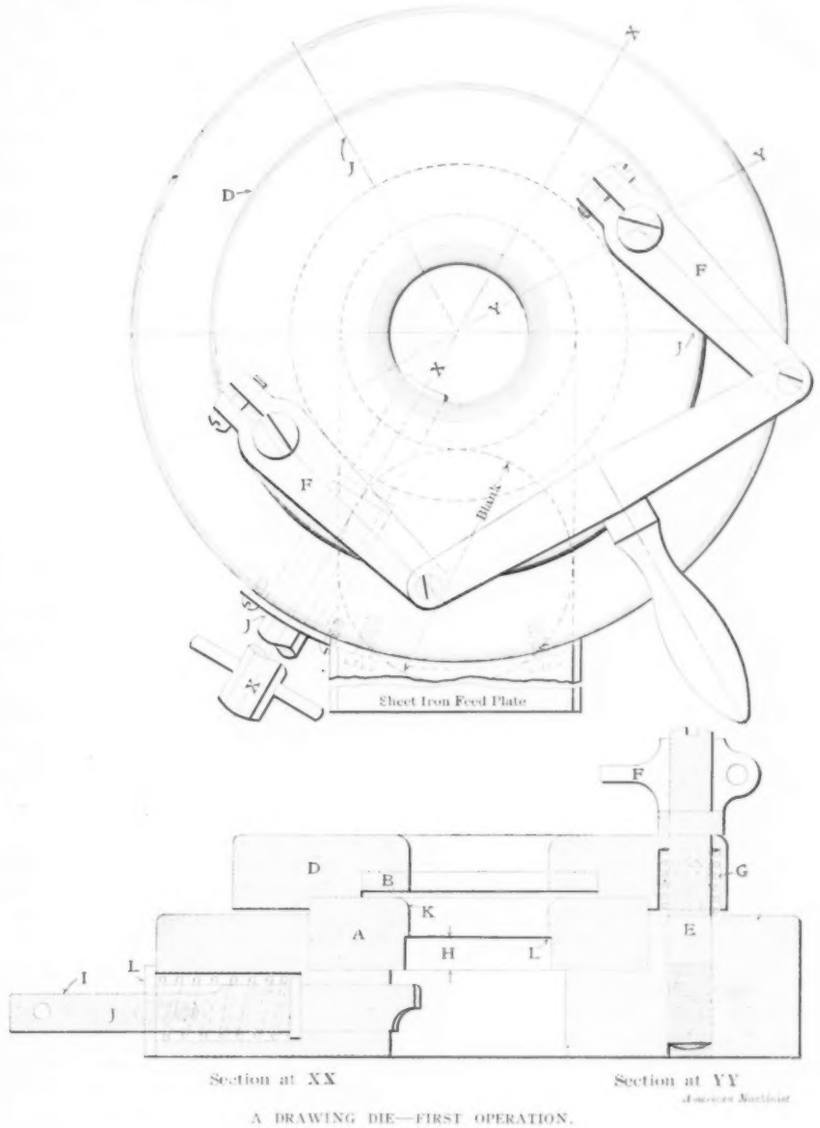
J. SCHURING.

Milwaukee.

A Drawing Die.

Editor American Machinist:

The sketch shows a die for the first operation in drawing a shell from a No. 14 sheet metal blank. The diameter of the blank is 5¼ inches.



A DRAWING DIE—FIRST OPERATION.

The drawing die *A*, made of tool steel, has two important features at *K* and *H*. The rounding at *K* is ½ inch; if made smaller the bottom will tear out, and if larger, wrinkles will form and tear the metal at the top. For this size blank the smallest punch that can be used with success for the first operation is 3 inches; smaller will tear the bottom out of the metal. *H* provides clearance and also serves as a stripper.

D is a cast-iron guide and clamp plate. *B* is a hardened steel ring inserted in *D*. This is the diameter of the sheet metal blank. *E E* are clamp bolts operated by levers *F F*. *G* is one of the springs to keep *D* up while the stock is being fed in under the punch. The purpose of *D* is to hold blank down while drawing; if this is not done the metal will wrinkle and make bad work. *B* is inserted to overcome the hard wear in drawing. *F* is secured to *E* by a split clamp; the reason for this is that after *D* is clamped on the blank, *F F* are set and made fast in a convenient position for the right hand of the operator, leaving the left hand free to feed the blanks on the sheet-iron feed plate.

I do this drawing on a large Stiles geared press, which runs continuously. Some mechanics insisted that I could do

this drawing on a toggle press only, but over 200,000 have been drawn on a single-stroke press. The cast-iron die-holder is superior to an all-steel die. A steel die of the size would be costly in material and labor. I harden the inside of the die only, and this I make as hard as possible. A quarter turn of *E* will release *D* sufficiently to allow one, and *only one,* blank to be fed under the punch.

J is three strippers for this heavy work. When the blank is being drawn, the stripper is forced out, and is forced in by the spring when the blank is down far enough to be stripped. *L* is a plate made fast to the base to keep stripper in proper position. The small pin is for the purpose of testing stripper to see that it is working right.

Care must be taken, when finishing the end of the stripper, that it will not scratch the metal. To avoid this I make the radius of the stripper end larger than the radius of the die, this causing the center and not the ends to strip. The reader may ask, "Why use two *E* bolts?" This is done to bring *D* down flat on the blank; if one side clamps and the other is loose the latter allows the metal to wrinkle. Many a good punch, die or punch press is spoiled by improper means for clamping blanks while drawing and for stripping after drawing. The method of feeding the blanks to the punch is optional with the maker. A small sheet-iron feed plate screwed to the die-holder provides for three blanks, one after the other, the operator feeding the blanks with the left hand and operating clamp *D* with the right.

D. G.

Meeting of the National Association of Manufacturers.

The above named association met at New Orleans April 14, and the convention was unusually well attended. The opening address of President David M. Parry consisted of a vigorous arraignment of trades unions. Practically all their principles and practices were condemned by him in the severest terms, and he expressed the belief that unless checked they would ultimately lead us into socialism and rob this country of its prestige as an industrial nation. His address would be apt to give a shock to those of our British cousins who have been explaining that one of the reasons for our rapid advance here is our "freedom from union dictation." The temper of his address may be perhaps best inferred from the fact that he denounced conciliation as a myth and arbitration as a failure. He described Chicago as the headquarters of unionism, attributed its sad civic condition to that fact and concluded that part of his address by saying that Chicago "will be in the hands of martial law in a very few months, unless there is an awakening of the civic pride which shall put an end to the lawlessness now throttling the city."

The speaker especially denounced the eight-hour law and the attempt to limit the power of granting injunctions and of punishing for conspiracy, and said they should have been entitled "Acts to Repeal the Bill of Rights."

The resolutions adopted by the convention were much more moderate in tone, and declare as follows:

"Fair dealing is the fundamental and basic principle on which relations between employees and employers should rest.

"The National Association of Manufacturers is not opposed to organizations of labor as such, but it is unalterably opposed to boycotts, blacklists and other illegal acts of interference with the personal liberty of employer and employee.

"No person should be refused employment or in any way discriminated against on account of membership or non-membership in any labor organization, and there should be no discrimination against or interference with any employee who is not a member of a labor organization by members of such organizations.

"With due regard to contracts, it is the right of the employee to leave his employment whenever he sees fit, and it is the right of the employer to discharge any employee when he sees fit.

"Employers must be free to employ their work people at wages mutually satisfactory, without reference or dictation on the part of individuals or organizations not directly parties to such contracts.

"Employers must be unmolested and unhampered in the management of their business and in the use of any methods or systems of pay which are just and equitable.

"No limitation should be placed upon the opportunities of any person to learn any trade to which he or she may be adapted.

"This association disapproves absolutely of strikes and lockouts and favors an equitable adjustment of all differences between employers and employees.

"The National Association of Manufacturers pledges itself to oppose any and all legislation not in accord with the foregoing declarations."

Resolutions providing for the appointment of a committee to deal with the work of forming a central organization to deal with labor questions in a collective, scientific and effectual manner were also adopted. Mayor Jones, of Toledo, who is a manufacturer in a large way, made an address in which he protested against the exhibition of any bitterness towards union labor. He defended unions, said he urged his own men to belong to them, thought the unions had been great educators and was opposed to any war upon them.

Mr. Parry's attitude upon the labor question was by no means endorsed by all the delegates, and many of them considered that his statements were intemperate and unwise. On this account there was some talk of opposing his re-election to the presidency, but nothing of this appeared upon the surface, and his re-election was by unanimous vote. Marshall Cushing, of New York, was elected secretary, and F. H. Stillman, of New York, treasurer.

There was considerable discussion of the tariff question, Charles Norman Fay, of Chicago, strongly urging that the association put itself on record as favoring a revision. He was supported by several members and opposed by others, the matter being finally disposed of by a vote, carried by a large majority, to lay upon the table, thus cutting short what seemed likely to be a long tariff debate. Pittsburg was chosen as the place for the next meeting.

Report of a Committee of the National Association of Manufacturers on the Metric Question.

Our readers will remember that as a result of discussion of the metric question at conventions of the National Association of Manufacturers a committee was appointed to submit a series of questions to the membership and to prepare a summary of the replies. The report of this committee has been submitted, and a copy of it is before us. From it we extract as follows:

To the National Association of Manufacturers:

In accordance with instructions, your Committee on Weights and Measures has submitted to the members of the association a series of questions with a view to ascertaining their views regarding the general advisability of the adoption of the metric system by this country, and specifically regarding the desirability of the passage of the bill reported to the last Congress by the House Committee on Coinage, Weights and Measures, and we submit as our report the following summary of the replies:

The total number of replies received was 264. In some cases some of the questions were passed over without reply, and in others the answers to some of the questions were too uncertain in tone to permit their being treated as categorical answers. We have in the following summarized the answers to the best of our ability and have endeavored to show by examples how some of the less clear answers have been treated in the classification. No interpretation of these votes would materially change the result.

Question No. 1—Would the adoption of the metric system tend to increase foreign business in the line you represent?

The answers to this question are as follows:

Yes	60
No	175
Non-committal	12

Question No. 2—Would the adoption of the metric system be beneficial to domestic business in the line in which you are engaged?

The answers to this question are as follows:

Yes	34
No	206
Non-committal	4

Question No. 3—Would the adoption of the metric system by our government, for any or all of its departments, including customs houses, arsenals, navy yards and public works, be detrimental to your business?

The answers to this question are as follows:

Yes	98
No	137
Non-committal	2

The answers to this question must of course be viewed in the light of the fact that many manufacturers do no business with the government, and all such would necessarily answer no.

Question No. 4—Would it induce the adoption of the metric system by manufacturers and others in private transactions?

The answers to this question were as follows:

Yes	109
No	100
Non-committal	26

Question No. 5—If our export business should largely increase with countries using the metric system—

(a) Would such increased business lead them to accept our English measurements with less objection than hitherto, or

(b) Would it lead to the introduction of the metric system by this country under the operation of the natural laws of supply and demand without further legislation?

The answers to question (a) are as follows:

Yes	77
No	81
Non-committal	23

The answers to question (b) are as follows:

Yes	105
No	92
Non-committal	25

The answers to these two questions are more general in form and hence more satisfactory than the replies to the other inquiries. In many cases no direct answers were given, the voters' intentions being a matter of inference from their general remarks.

Question No. 6—Assuming the desirability of an international system of weights and measures, is it of sufficient consequence to justify incurring the following acknowledged disadvantages:

(a) The abandonment, or necessity for re-writing, all non-metric engineering literature?

(b) Changing our small tools and standard gages now based upon the standard inch?

(c) Abandoning the inch with its binary divisions in common use, such as the half, quarter, eighth, sixteenth, thirty-second, sixty-fourth, and the decimal divisions of the inch?

(d) Abandoning the present standard screw threads, which are based upon the inch?

The answers to question (a) are as follows:

Yes	55
No	153
Non-committal	13

The answers to question (b) are as follows:

Yes	47
No	150
Non-committal	12

The answers to question (c) are as follows:

Yes	50
No	151
Non-committal	10

The answers to question (d) are as follows:

Yes	49
No	152
Non-committal	9

The answers to this series of questions are in very satisfactory form. In nearly all cases they are categorical, and in few or none is there any doubt as to the views of the voter. Five voters do not consider that the adoption of the metric system would entail the abandonment of the present standard of screw threads. These five votes have been counted as *Yes*.

Question No. 7—Should Congress enact any law to enforce the use of the metric system in any of the departments of the Government?

The answers to this question are as follows:

Yes	51
No	156
Non-committal	6

The answers to this question, like those to the last set, are in such form as to lead to very little uncertainty regarding the voters' intentions.

Question No. 8—In view of the fact that the metric system was legalized by Act of Congress in 1866, and has therefore been on a legal equality with the English system for thirty-six years, to what extent have you made use of it and what has been your practical experience with it?

The answers to this question, while not always in the following words, may be classified as follows:

None	132
Practically none	8
Very little	15
To a limited extent and in a few instances	8
In some departments	2
In one department	2
In laboratory	5
In foreign business (export or import)	27
In special cases or when required	13
In correspondence	3
Some	3
Largely	1
Whenever possible	1
Non-committal	3

The report says:

As question No. 8 is the most comprehensive in its scope, the replies brought forth considerable comment and opinion of a general character. The appended extracts embody practically all that was was brought out in the way of experience and general opinion regarding the metric system.

Then there follow extracts from a number of letters from manufacturing concerns. We do not print these from considerations of space, but a fair summary of them is as follows: Six have had no experience with the metric system and are opposed to it. Five who have had no experience with it favor it. One has had experience with it and opposes it. Six have had experience with it and favor it. From the remaining nine no very definite conclusion can be drawn within the above classification.

The report closes as follows:

Your committee was not instructed to submit any specific recommendations as to the attitude which this association should assume toward legislation touching the metric system, but merely to ascertain the prevailing sentiment among the membership with regard to the enactment of any legislation favorable to the metric system. It would seem to be quite clear from the analysis of the replies received from the members of the association that the prevailing sentiment is adverse, at least to the bill which was favorably reported to the House during the last session of Congress, but which was subsequently withdrawn. The withdrawal of this bill, however, is not understood to indicate an abandonment of the effort to secure some legislation of this character, as it is very clearly understood that the same bill will be reintroduced in the near future.

THEODORE C. SEARCH, Chairman,
WILLIAM SELLERS,
ALBA B. JOHNSON,
JAMES M. DODGE,
Committee.

A committee, appointed by the Secretary of State for War, has for some time been considering the question of the production of standard leading screws for lathes for use in government workshops and elsewhere. A machine for this purpose has been built by Sir W. G. Armstrong, Whitworth & Co., to designs approved by this committee, and is to be placed at Bushy House in charge of the committee. The Office of Works have now under consideration the plans of a special building for this machine. It will be the duty of the committee to issue to the government workshops and to the trade certified copies, made by this machine, of the standard screw.—*The Engineer.*

A warm mill is a good thing all around, but the heating should not be done by hot journals.—*American Miller.*

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The Bureau of Manufactures.

In the new department of the United States Government, that of Commerce and Labor, there are bureaus and bureaus. That is, they are not all of the same actual or relative magnitude. None, we are sure, can have a more important and, if properly filled, a more helpful and beneficent function than that of the Bureau of Manufactures. It is proper to suggest that its success and usefulness will depend largely upon the attitude and the assistance of those whom it purposes most to benefit. It is announced that it is the mission of the bureau to foster, promote and develop the various manufacturing industries of the United States, and the markets for the same at home and abroad, by gathering, compiling and publishing all available information and by any other methods that may be found useful. The consular officers of the United States, including consuls-general, consuls and commercial agents, although under the authority of the Department of State, are required to gather and compile information and statistics that shall be useful to American manufacturers for the special use of the Bureau of Manufactures. The consular reports have already amply demonstrated their value to the commercial and manufacturing communities, but they have also and more distinctly suggested the possibilities they command for more extended and more pertinent usefulness. Up to the present time they have not generally represented the results of intelligent, systematic and exhaustive gathering of information so much as they have an incidental if not a haphazard noting of whatever may have forced itself upon the notice of the senders. The reporters of the information which has thus far been conveyed have usually labored under the great disadvantage of not having the requisite technical knowledge for even recognizing or discovering, much less for correctly reporting, the information most desirable for the help and guidance of manufacturers. It is to be hoped and expected, therefore, that this work will be arranged to be done more systematically, or in pursuance of some definite and comprehensive plan, and that it shall be done as extensively and thoroughly and constantly as possible. To this end it is most desirable that not only the head of the bureau but his co-operators, assistants and subordinates shall have the special knowledge and training that will best fit them for this special work. In the domestic department of the work of the bureau it could of course be assisted by co-operation with the Bureau of Labor, and, indeed, it may not be easy to sharply apportion and separate what shall belong to the one and what to the other. It should not be necessary to say that both of the bureaus in which we are here most interested should be absolutely free from bias, and from all predilection for making out a case in any interest whatever.

At the present stage it will be very proper, and it would seem to be most desirable, that all who have ideas as to the functions of the Bureau of Manufactures and as to the means and methods by which it may be made most useful should freely advance their suggestions. When it gets fully under way it will not be a thing to be wondered at if some plain criticisms are called for, and especially so if in general it proves itself well worth the criticising.

The European Zolverein.

The International Agricultural Congress at Rome decided to postpone action upon Count von Schwerin Loewitz's proposition for a European combination or zolverein against America, with the object of shutting her out of European markets. In the course of the debate upon the matter, the press dispatches state that Signor Luzzatti, who has been three times Italian Minister of the Treasury, and who is considered the highest Italian authority on questions of commerce, expressed his astonishment that in the presence of the high tariffs just voted by Germany and Switzerland and the tariff now being prepared by Austro-Hungary, any dare suggest a European customs union to oppose American competition. Is there hope for a European agreement, he asked, before declaring war on the United States? It would be ridiculous to threaten war, he said, without an understanding among the allies. Even the renewal of the present European treaties was difficult. The existing tariffs were so enormous that they were threatening to put back Europe economically to the Middle Ages.

How was it possible under such conditions to fight the United States, of which he must speak with respect? Her greatness imposes prudence while her force commands. Italy, especially, cannot take the matter too lightly, as she not only sends goods to America, but men who are going to seek their liberty, work and prosperity. The present threat was not serious because a customs union was impossible among the European nations. If it was possible, America would defend herself, and how could Europe compensate herself for the damage that America could do?

In other words, this Italian statesman evidently recognizes the fact that the United States is composed of fifty-two states and territories, together covering an area greater than that of all Europe put together; that within this territory the benefits of absolute commercial liberty are enjoyed, and that before Europe can hope to successfully wage a commercial war against us, or to be economically independent of us, she must within European territory secure a like advantage. This, Signor Luzzatti declares, is impossible, and points out that the trend of present political movement is away from any such removal of the burdens from interstate

commerce within Europe. In other words an attacking army must be harmonious and must act in concert.

A summary of the report of the Moseley Commission, which came over here to study our industrial conditions, has been cabled over and seems to again illustrate the familiar fact that an observer can usually find and see what he is looking for and will be blind to all else. The general conclusions arrived at are that British workmen have nothing to learn from American; that most of the inventions of value in American industrial establishments are by men of European birth, etc.; though it is acknowledged that there is here a greater dispositon to welcome new machinery and methods, and to recognize that brains, not brawn, are the thing of most importance in the development of industries.

The Association of German Machine Tool Manufacturers is taking up with its members the proposition for a collective exhibit at the St. Louis World's Fair. Not very much interest has previously been felt by these tool builders in the exposition, but the Imperial Government is anxious that German industry shall participate, and the Prussian trade ministerial department is endeavoring to awaken the enthusiasm of the tool manufacturers. It is an official opinion that the manufacturers of the nation, and especially the tool builders, ought to lay their products before visitors at the St. Louis fair in order to increase their sales in North, Central and South America, the West Indies and Eastern Asia. We understand that Ludwig Loewe & Co., of Berlin, have early signified their willingness to take part in a collective exhibit.

The Coes Wrench and Its Inventor.

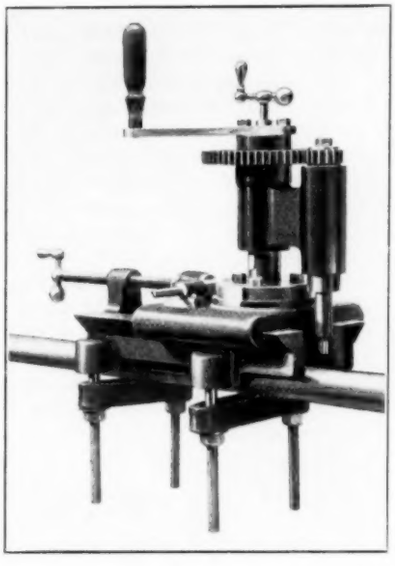
Next to the hammer the most familiar and constant tool of the machinist is undoubtedly the monkey wrench, as we all call it. It belongs not only to the machinist, but to the workers in the various other trades, to all who have to do with the steam engine or who operate machinery for any purpose. The wrench which has held its own against all comers and which to-day is most extensively used is undoubtedly that of the Coes type, and one of the remarkable careers in mechanical lines is that of Loring Coes, the inventor of it. He has just passed his ninety-first birthday, is still inventing and is still looking after and pushing the wrench business.

His career, a sketch of which has lately been put out for general circulation, is quite an interesting one if only his connection with the development of the wrench is considered, although he has for most of his life had also other mechanical interests. He began life on a New England farm, going to school in the winter, and when fourteen years old was apprenticed to a carpenter, and followed that line for a number of years, becoming later a contractor for the wood work in a woolen machinery factory, and at the age of twenty-four having saved $1,200, he then went into business with a younger brother and three years later they were burned out, losing nearly everything and being unable to start again. The brothers went to work as patternmakers, and while thus working the wrench was invented, the first patent issuing to Loring Coes in 1841. They began at once the manufacture of the wrench, with the help of capital furnished by a hardware dealer of Worcester, Mass., who sold the wrenches for them. In 1843 they were able to purchase the machinery and tools. The business continued to grow rapidly, and various improvements on the wrench were successively patented, the manufacture being carried on in connection with that of shear blades and knives for hay-cutting machines. In 1869 the brothers separated, but the improvements devised by Loring Coes compelled a reconsolidation, nephews of Mr. Coes coming in as partners. A month or so before his ninetieth birthday Mr. Coes bought out the other interests and became sole owner of the wrench business. Mr. Coes is at his office daily and has "patents pending."

Some New Things.

NEW PORTABLE KEYSEATER.

The half-tone shows a portable machine for finishing out the ends of milled keyseats and for truing up the sides of keyways which have become worn through

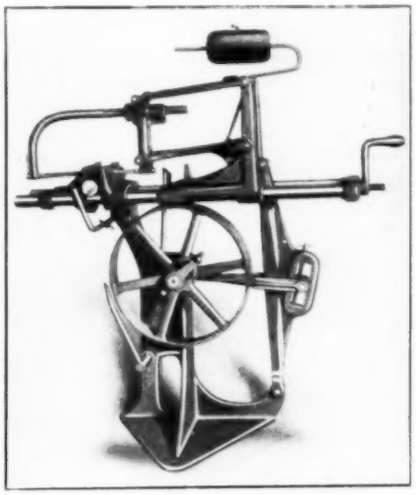


PORTABLE KEYSEATER.

gears, pulleys and couplings working loose on their shafts. The machine has a capacity for shafts up to 6 inches in diameter, and will mill close up to a shoulder or flange. The under side of the bed is of "V" form, so that when the machine is fastened by the clamps it will be parallel with the shaft. The cutter spindle is carried by a head which swivels on the slide, the set-over for truing up worn keyseats being obtained by means of a worm and wheel adjustment. The sliding member in which the spindle is fitted is provided with a feed screw, by means of which the cutter is lowered to the proper position; and provision is made for locking the head when correctly set. The spindle is turned and the machine fed by hand, the slide having a longitudinal movement on the base of 8 inches at one setting. John T. Burr & Son, 32 South Sixth street, Brooklyn, N. Y., are the manufacturers.

POWER HACKSAW.

This saw is made with an adjustable frame and will take blades from 9 to 14 inches long. The cut is only on the backward stroke, the blade clearing the work



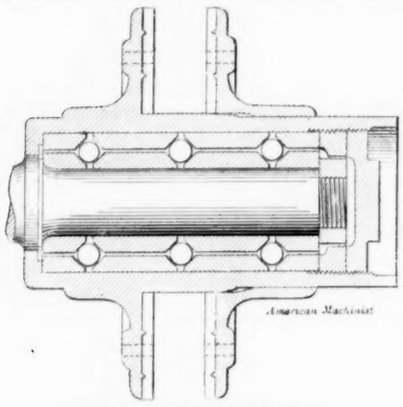
POWER HACKSAW.

when moved forward. The pressure upon the work is applied by the adjustable weight located, as shown, near the rear end of the connecting links which reciprocate the saw. The main or rocker arm actuated from the driving shaft is pivoted at the base of the machine and provided with a slot in which the connecting-rod block may be shifted to vary the stroke of the saw. Provision is made for adjusting the blade in its holder to insure its cutting properly; and an automatic trip is provided by means of which the machine is stopped when the piece is severed or when the saw has cut to any desired depth. The clutch for connecting the shaft and pulley is shown at the front of the latter. This saw is made by the Fairbanks Company, corner Broome and Elm streets, New York.

THE GURNEY BALL BEARING.

The accompanying drawing shows the construction of this bearing as applied to the wheels of a truck for the Westinghouse Machine Company at East Pittsburg, Pa. The novel feature is in the provision for equalizing the bearing on

each set of balls. The rings which form the races for the balls, while all held in by the nut at the end, are free to move endwise individually enough to equalize and distribute the pressure over all the balls in case of wear or imperfect alinement. For heavier service the rings may be made narrower and more sets of balls may be introduced in the same length of bearing. For shafting or other places appropriate means of securing the rings will suggest themselves. The bearings are made either solid or split, as required. They are made by the Gurney Ball Bearing Company, Jamestown, N. Y.



THE GURNEY BALL BEARING.

Technical Publications.

"How to Become a Competent Motorman." By V. B. Livermore and James Williams. 232 4x6-inch pages, with 45 illustrations. D. Van Nostrand Company, New York. Price, $1.00.

This is a highly useful and strictly practical little book by the chief instructor and shop foreman of the Brooklyn Rapid Transit Company. It describes the electrical equipment of the trolley car, the troubles which arise in its operation and the methods of overcoming them and getting the car in without help. It is of convenient size for carrying in the pocket and can be recommended to all motormen who aspire to an understanding of the machinery in their charge.

"Reports of the Tests of Metals and Other Materials for Industrial Purposes" made with the United States testing machine at Watertown Arsenal during the fiscal year ended June 30, 1901. 659 6x9-inch pages, with numerous tables, text illustrations and folded diagrams. The Government Printing Office, Washington.

This volume records over 3,700 tests of various materials, many of which were made for various government departments and for private parties, although the majority were for purposes of investigation, of which latter the most comprehensive related to cement and cement concrete, and these have furnished some important information. Many phases of the properties of cement and results of various methods of cement treatment were investigated. Among these were included the fineness of grinding, the rate of setting as influenced by the quantity of water used in gaging, the effect of retarded setting and of setting at various temperatures down to zero Fahr.

"Continuous Current Dynamos and Motors and Their Control." By W. R. Kelsey. 440 5x7-inch pages, with 225 illustrations. The Technical Publishing Company, Limited, London. Price, 5 shillings.

This book is intended more especially for mechanical engineers. The fact that the dynamo and motor have become familiar objects in workshops and the certainty that their use will rapidly increase makes familiarity with them of increasing importance. The author expects to see them designed and made in engineering workshops as freely as steam engines are today, and his book is therefore a treatise on design and construction rather than a descriptive account of types and properties. The treatment of the subject is simple and but mildly mathematical, while it begins with the elements of the subject. The author looks upon dynamos and motors as essentially machines, and he hence devotes more attention to mechanical, as distinguished from electrical, features than is customary.

The Yale & Towne Manufacturing Company have adopted a novel plan of securing first-class ammunition to be used in advancing knowledge regarding their chain blocks. They offer prizes for the best statements of fact regarding the use of these blocks by actual users of them, the prizes ranging from $100 cash down to $10 cash, with an additional cash prize of $25 to the man who has made the best record of hoisting speed and efficiency. Full particulars regarding these prizes can be obtained by addressing the company at 9 Murray street, New York.

One of the beneficent institutions of New York city is the Hospital Saturday and Sunday Association, and one of its auxiliaries is that of the iron, steel and machinery trades. One hundred firms in these lines doing business in New York city have recently contributed $5,952 to the maintenance of the work of the association, no contribution exceeding $100.

Pawling & Harnischfeger, of Milwaukee, Wis., desire us to correct some exaggerations of the daily press regarding a fire which occurred in their place April 15. They say that the fire was confined to one building, and that it will put them back with their work for only a few days—that the delay in filling orders will be scarcely noticeable.

In Omaha, Neb., what seems to be a new element in labor disputes has been introduced. Some men in the building trades having struck and others threatening to do so, the merchants of the city are reported to have organized a boycott against them and refused to sell goods or materials of any kind to anyone who employs union labor.

The John Fritz Medal Association has been incorporated at Albany.

Personal.

Charles L. Griffin, professor of mechanical engineering, Syracuse University, has resigned his position.

George Whale has been appointed chief mechanical engineer of the London & Northwestern Railway in place of F. W. Webb, retired.

D. Walter Brown and Henry V. Brown, patent attorneys, announce the removal of their offices from 111 Broadway to 45 Cedar street, New York.

George H. Day has resigned the presidency of the Electric Vehicle Company, of Hartford, and will be the general manager of the Association of Licensed Automobile Manufacturers. Ex-Governor M. G. Bulkeley, of Hartford, succeeds Mr. Day.

Gus C. Henning, M. E., has become interested in the Steel-Set Diamond Company at 275 Water street, New York. This is a company which is to operate under German patents in setting and supplying diamonds for all mechanical purposes, set by an improved process, giving greater security and endurance. Besides managing the new company Mr. Henning will continue to practice his profession as consulting engineer.

George Kirkegaard, the expert model maker and electrician, was tendered a testimonial banquet on April 14, the eve of his departure for Europe. The affair was arranged by Mr. Kirkegaard's Danish friends in New York, and was in recognition of his services in the promotion of the interests of Danish people in the United States. Mr. Kirkegaard has been president of the leading Danish society of New York, and was the leading spirit in collecting the fund to erect the statue of Thorvaldsen, now standing in Central Park. The dinner was given at Terrace Garden and was attended by some two hundred of the most prominent Danes in America. A notable feature of the occasion was the presentation to Mr. Kirkegaard of a handsome watch and chain.

Forrest H. Blanding, who was formerly in charge of the department of the Union Iron Works in which mining machinery is built, and who for the past fourteen months has been master mechanic of a large gold mining company in South Africa, has returned to America and is on his way home. He has some very interesting souvenirs of his South African trip, and his narratives of travel and of experience there are exceedingly interest-

ing. He expresses the opinion that there is likely to be a very great industrial development in that country within the next few years. He says that all the mining companies there are preparing to spend large sums of money in additional equipment, and he thinks that in the course of time it may become an agreeable place in which to live, though under present conditions one has to put up with a good many hardships and inconveniences.

Obituary.

Col. J. E. MacGowan, editor of *The Tradesman*, Chattanooga, Tenn., died at Missionary Ridge April 12, seventy-one years old.

David Russell, who was for thirty years general superintendent of the Brooks Locomotive Works, Dunkirk, N. Y., retiring a year ago, died at Fredonia, N. Y., April 14.

Commercial Review.

NEW YORK, Monday, April 20, 1903.

Business in the machinery district during the past week was rather quiet. In machine tools there was an absence of large propositions, but the buying of one and two tools at a time was a distinguished feature. Inquiries were reported to be up to the usual aggregate, and made machinery men take an optimistic view of the outlook.

Considerable surprise was occasioned by the announcement that the Chicago Pneumatic Tool Company, at its meeting held in this city on last Thursday, had passed the usual quarterly dividend of 2 per cent. This was followed on the following day by a decline of 25 points in the company's stock, with a partial recovery afterward.

In speaking of the matter, President J. W. Duntley said to the writer: "We decided to suspend the payment of the dividend because we didn't deem it desirable to pay it. We can use the money the payment of it would have represented to better advantage, and the best interests of the company and stockholders will be subserved thereby. We are a young company and have paid dividends at the rate of 8 per cent. a year since we have been organized. This is something which cannot be said to the credit of many new companies.

"The fact cannot be too strongly emphasized that our failure to pay the dividend was not because we did not earn it. As a matter of fact our earnings were sufficient to enable us to pay it, but as I have said, we can utilize the money to better advantage. The business of the company was never in a more prosperous condition than it is now, our earnings for the first quarter this year, for example, being considerably above those for a similar period last year. The outlook, too, is of the best.

"We are constantly making improvements in our plants in order to fill our increasing orders with greater facility. This was why we decided recently to transfer our Aurora plant to Cleveland. We are making considerable headway with our new plant in Scotland, but we will not purchase the necessary machinery for probably two or three months to come. We estimate the plant will cost us about $350,000, of which about $150,000 will be devoted to buying machinery, all of which will be of American make."

In trade circles, the general belief is, and Mr. Duntley's remarks would seem to corroborate it, that the company made a mistake in paying dividends from the start, at least at the rate it did. This is a practice which does not obtain very largely nowadays, and many conservative financiers don't approve of it, they contending that the path of new companies, as a general rule, is not always strewn with roses, and that no amount of ready cash is too large. It was the want of the latter, as will be recalled, that forced the American Bicycle Company into the hands of the receiver, and which came very near putting the Consolidated Lake Superior Company into difficulty recently. The action of the Chicago Pneumatic Tool Company is not without precedent, the Wm. Cramp & Sons' Ship & Engine Company having passed its December dividend for the very reasons Mr. Duntley mentions.

The iron and steel industry has come in for considerable attention at the hands of Wall Street operators recently, especially those who are bears on the market. The latter seem to gloat over some things which have occurred, as indicating a "turn in the tide" of the industrial prosperity of the country, of which the iron and steel industry is recognized as an unfailing barometer, even by such a good authority as J. P. Morgan. These bearish interests make considerable capital out of the decline in the earnings of the United States Steel Corporation for the first quarter of this year, although reticent about the unavoidable difficulties which made them possible, and singularly unmindful of the excellent showing the earnings of the corporation for 1902 represent over the earnings of 1901. Then they refer to the recent reductions made in pig iron, forgetting that it is due largely to increased production, and that all reports agree that the consumption is keeping pace with it. Lastly they have added to their stock in trade by alluding to the action of the Chicago Pneumatic Company in connection with its dividend, overlooking the anything but apprehensive views President Duntley has expressed in the matter.

All these things should not occasion any alarm. Wall Street bears generally view things as they would like them to be, rather than as they really are. The purpose to be served controls. Last year was the most prosperous year the country has ever known, yet at any time throughout it pessimists could find the greatest encouragement in Wall Street. At the present time commercial agencies are furnishing plenty of information that the "turn of the tide" has given no valid premonition of its advent, and manufacturers of red flags find the demand for their product to be the slowest since they have been in the business.

The annual report of the General Electric Company for the fiscal year ended January 31 will be issued in a few days, and will show the earnings of the company to have been about $8,500,000, or equivalent to about 19 per cent. on the present outstanding stock. From time to time we have alluded to the prosperous condition of the electrical machinery industry during the past year, and nothing perhaps bears out our remarks so well as the report of the General Electric Company.

The business of the company has grown to immense proportions, especially in turbines, an official of the company being our authority for the statement that the company cannot execute some of the orders on its books for large turbines in less than three years, and that it has orders booked for other electrical machinery manufactured by it that will keep its shops going at their maximum capacity for at least a year. Machine tool men have found the company one of their best customers during the past year, and from what we hear, the company will give a good account of itself in this direction in the year to come, if some of the plans we know to be in an embryonic state now, are carried out.

Other manufacturers of electrical equipments, like the Westinghouse, Sprague, Triumph, Western, Commercial, Crocker-Wheeler, C. & C., Akron, Milwaukee, Jantz & Leist, Eck, Storey and Northern Electric companies, express the greatest satisfaction with present and prospective conditions in their respective lines also.

The past week has been noticeable for the good tidings it brought forth in the labor situation, which recently has caused much concern in every department of the iron and steel industry. The settlement of the strike of the American Bridge Company employees, which threatened serious consequences, was a development that was most gratifying. Manufacturers of machinery with whom we have talked are felicitating themselves on the fact that they have no strikes on their hands now and do not expect any.

In the machinery district very few changes will occur on May 1, beyond those we have previously mentioned. Tomorrow George E. Affleck will move into the ground floor of 107 Liberty street, which will form much larger quarters than those he has heretofore occupied. His store stock of machine tools will be larger and more varied than any he has ever displayed.

The O. K. Tool Holder Company, Shel-

ton, Conn., report that their business is very brisk and that the volume of their past month's business was twice that of any previous month since they have been in business. Foreign business is somewhat better also. They are just adding to their line a new holder, ¾x1⅜ inch, to be known as size D, and are also putting out a larger cutting-off tool, ⅝x1¼ inch, and known as size C.

An electrical supply company in Lima, Peru, will install a 330 horse-power Westinghouse compound engine for generator driving, this being an extension to their present plant. Two hundred horse-power engine-type generating outfits have also been supplied to Negociacion Minerva do Promontorio, Durango, Mexico, and to S. Pearson & Son, limited, Salina Cruz, Mexico. The latter firm has also purchased a number of standard engine generating outfits.

The Mexican National Iron & Steel Company, also located at Durango, will install a 45 horse-power compound engine for general power work, and a 150 horse-power Westinghouse compound engine-type outfit will be installed by Michaelis Hallenstein & Co., Fookeray, Victoria, Australia, for lighting and power work.

The demand for Westinghouse junior engines of all sizes, especially from Chilian territory continues, and a large number of these engines are continually under exportation. The two 1,000-kilowatt Westinghouse steam turbine generating units for the De Beers mines at Kimberly, South Africa, have recently been shipped. These are the largest steam turbines that have been exported from this country up to the present time.

The favor in which American power apparatus is held by foreign capitalists is well illustrated in a recent light and power enterprise for Tripolis, Greece. The high price of coal at this location has induced the promoters to install gas power, with the intention of giving it a thorough trial. The fuel to be used will consist entirely of native lignite, which has been found to yield a gas of good quality, and quite suitable for power work. The plant will have a present capacity of about 125 horse-power, and Westinghouse three-cylinder vertical producer gas engines will be used. There will be two of these engines, each belted to a generator, which will supply the present demand for current. The engines will be supplied with fuel gas from Taylor producers, furnished by R. D. Wood & Co.

CHICAGO MACHINERY MARKET.

Machine tool representatives, who draw fine distinctions, say that business is not so good as a month ago. They add, however, that if trade continues as now they will have no occasion for criticism. For there is quite a fair trade current. The railroad shops have been among the good buyers. The Northwestern road has bought a small equipment for its shops at Winona, Minn., amounting, it is estimated, to at least $20,000. The Atchison, Topeka & Santa Fe road has lately appeared with inquiries for from 100 to 200 machines, many of them large, and many, too, motor driven, the aggregate requirements, it is said, running up somewhere between $50,000 and $100,000. The Rock Island road has placed a portion of its orders for the new Moline (Ill.) shops, but the Chicago & Eastern Illinois is still negotiating for the equipment of its Danville (Ill.) plant. The machine shop departments of manufacturing companies are also good buyers of tools, though there are said to be few if any large inquiries now in the market.

The lead which wood-working machines have had in this market for several months past by way of activity over iron-working tools continues, and there are not heard any reports except of the most sanguine kind in that field of production. The rule is for the factories to be reported sold up for months ahead. One manufacturer of wood-working machine tools says he is not sending any salesmen out on the road except to follow up inquiries, the returns from these more than giving the factories enough orders to keep them busy, without seeking any trade. One representative relates that three years ago his company built on order from an agricultural implement manufacturer a large machine for special work, which was a great economizer. Quite recently, through one of the workmen, who left this shop for another, the work of this tool was made known, and now the builder has a lot of inquiries for the same, every competitor wanting one. The lumber and furniture interests have not abated their strenuous demand for machine tools, building generally throughout the West being remarkably active. A salesman from Western Kansas says the farmers in that locality have so much money that they are buying automobiles or any attractive "proposition" that comes their way. But they are not neglecting farm machinery, new houses and barns and the regular channels of expenditures.

McDowell, Stocker & Co. will before May 1 move back into their old quarters, at 59-61 South Canal street, where they have leased the entire four floors and basement, or nearly twice the space they occupied before.

The American Wood Working Machinery Company have sold a $10,000 order to the Thomas Jackson Company, Saginaw, Mich., and another large order to Chapman & Dewey, Jonesboro, Ark.

Quotations.

NEW YORK, Monday, April 20.

New York prices for Northern and Southern irons for nearby delivery are as follows:

Northern:

No. 1 X	$21 50 @ $21 75
No. 2 X	20 25 @ 20 75
No. 2 plain	19 75 @ 20 25

Southern:

No. 1 Foundry	21 50 @ 21 75
No. 2 Foundry	20 50 @ 20 75
No. 3 Foundry	19 50 @ 19 75
No. 4 Foundry	19 00 @ 19 25

Bar Iron—Base sizes—Refined brands, mill price on dock, 1.95c. upward in carload lots. Smaller quantities from store, 2.15@2.30c.

Tool Steel—Base sizes—Good standard quality, 7c.; extra grades, 10c. and upward.

Machinery Steel—Base sizes—From store, 2.10@2.25c.

Cold rolled Steel Shafting—2.90c. from store for base sizes.

Copper—Lake Superior ingot 15@15¼c.; electrolytic, 15@15¼c.; casting, 14½@14¾c.

Pig Tin—In 5- and 10-ton lots, f. o. b. New York, 30@30.20c.

Pig Lead—4.67½c. in 50-ton lots.

Spelter—5.50@5.65c.

Antimony—Cookson's, 8¼@8½c.; Hallett's, 6¾@7c.; other brands, 6½@6¾c.

Lard Oil—Prime City, 85@87c., according to brand and quantity, ranging from one barrel up to large lots.

Manufacturers.

The Nashville (Tenn.) Railway will erect a stone-crushing plant.

William Gerhardt, Mahanoy City, Pa., may manufacture a shirt cutting machine.

The Herron-Brady Pump Works will build a $75,000 plant at Chattanooga, Tenn.

A new shop is to be built by the Cornwall Railroad Company at West Lebanon, Pa.

The New York Air Brake Company has a new plant in project at Watertown, N. Y.

Work has begun on the enlargement of the Chesapeake & Ohio shops at Clifton Forge, Va.

The New York Standard Watch Company, Jersey City, N. J., is thinking of erecting an addition.

The Dover Forged Iron Company has under consideration a factory site at Canal Dover, O.

Work is starting on an addition to the factory of the Cohannet Silver Company, Taunton, Mass.

F. W. Wurster & Co., rolling mill and axle works, Brooklyn, N. Y., are making extensive improvements.

Plans have been made for a machine shop addition, 120x140 feet, to the Etna foundry, Springfield, Ill.

The Hawk Knitting Company, manufacturer of hosiery, Reading, Pa., has bought a site for a new plant.

A contract has been let to build a new factory structure for the Regal Gas Engine Company, Coldwater, Mich.

The American Radiator Company, Chicago, Ill., will build a $100,000 factory at Litchfield, Ill., this summer.

A machine shop building, 30x60 feet, is about being erected for the Frankford Steel Company, Philadelphia.

The Ontario & Western is soon to rebuild its burned car shop at Norwich, N. Y. The shop will be 300 feet long.

It is stated that a factory of the Indiana Box Company, Anderson, Ind., which was recently burned, will be rebuilt.

A four-story addition, 49x66 feet, will be built to the Victor Talking Machine Company's plant, at Camden, N. J.

A new machine shop, 600x70 feet, is to be erected by the Saco & Pettee Machine Shops, at Biddeford, Me., this summer.

The Codding & Heilborn Company, manufacturing jeweler, North Attleboro, Mass., contemplates building an addition.

A consumers' co-operative foundry company is being organized at Toledo, O. The plant will be located in North Toledo.

An addition to the Industrial Works, manufacturers of special machinery, Bay City Mich., will be built this summer.

Construction contracts have been let for a piano factory at Sheboygan, Wis. The promoter of the enterprise is Arthur J. King.

The Maine Central Railroad, in Portland, is considering the question of rebuilding car shops at Thompson's Point, burned recently.

The John Van Range Company, manufacturer of ranges and stoves, Cincinnati, O., has let the contract for a large new factory.

The Richards & Sencenbaugh Manufacturing Company, manufacturer of door hangers, Aurora, Ill., has plans for a new factory building.

Work has begun on a foundry plant for the Chicago Heights (Ill.) Malleable Iron Company. The main foundry is to be 80x350 feet.

The Morgan Electric Machine Company, Chicago, Ill., will locate at Indiana Harbor, Ind., and has broken ground for its plant there.

The Gabel Manufacturing Company, manufacturer of water heaters, Pittsburgh, Pa., has been reorganized. The plant is to be enlarged.

The Simpson Manufacturing Company, washing machines and hardware specialties, Menaha, Wis., proposes to remove to Ladysmith.

The Atlantic Refining Company, Philadelphia, will build a machine shop, 146x63 feet, and a pump house at its plant at Point Breeze.

An addition will be made to the plant of the Waterbury Clock Company, of Waterbury, Conn. It will be 43x116 feet, five stories.

It is stated at Peoria, Ill., that C. E. Bonner has purchased land at Chrisman as a site for a plant to manufacture a new pipe wrench.

The West Virginia Mosaic Tile Company, of Fairmont, W. Va., has put up a temporary building and is about to erect a permanent factory.

The Fairbanks Construction Company, Marion, O., will erect a plant for the construction of steam shovels, dredges, wrecking cranes, etc.

Roth & Englehard, manufacturers of piano actions, St. Johnsville, N. Y., will erect a two-story addition, 100 feet long, to their main factory.

The American Net & Twine Company, Boston, Mass., will enlarge its Anniston, Ala., plant. A new engine-room will be one of the improvements.

The contract has been awarded for building an addition to the plant of the Poole Silver Company, manufacturer of plated ware, Taunton, Mass.

The Northwestern road will expend about $50,000 for the enlargement of the shops in Winona, Minn. Grading for the purpose is about beginning.

The Vulcan Iron Works Company, founder and machinist, Toledo, O., has purchased land on which it intends to erect four or five factory buildings.

J. M. Bach, St. Paul, Minn., has taken out a permit for the construction of a large trunk factory. A boiler and engine room will be constructed later.

C. T. Elliston and G. G. Avery, of Clinton, Mo., patentees of a new style riding plow, were recently looking for a place to put in a $100,000 factory.

It is stated at Charlotte, N. C., that stock has been subscribed for a new cotton mill at Statesville to cost $100,000. The prime mover is N. B. Mills.

The factory of the Empire State Sugar Company, Lyons, N. Y., has been leased by the Empire Beet Sugar Company, which will enlarge and improve it.

The Baker-Vawter Company, manufacturing stationer, printer, etc., Chicago, Ill., and elsewhere, will probably build a large plant at Benton Harbor, Mich.

F. B. Reddington, a Chicago machinery man, will erect a four-story factory building, 57x119 feet, at 107 Sangamon street, Chicago, at a cost of $25,000.

It is rumored that the plant of the Bethlehem (Pa.) Steel Company will be enlarged, and that most of the money will be spent on the armor plate department.

A company is being formed at Lebanon, Pa., by Joseph Shackleton, of New York, to manufacture a smoke consumer. The company will employ 200 men.

It is stated at Halifax, N. S., that plans have been made for a linen mill (main building about 400 feet long) of a company at the head of which is J. H. Pauley.

The Wilmington (Del.) Malleable Iron Company has taken out permits aggregating $210,000 for half a dozen buildings for its new plant in South Wilmington.

James Bonar & Co., incorporated, manufacturers of steam appliances, Pittsburgh, Pa., are building a machine shop and brass foundry, 50x95 feet, two stories.

The Norristown (Pa.) Covering Company, manufacturer of asbestos cement, etc., has decided to enlarge its plant and increase the capital stock from $50,000 to $100,000.

The Standard Sanitary Manufacturing Company, Pittsburgh, manufacturer of plumbers' enameled ware, is building an addition to its plant at New Brighton, Pa.

The Empire Coke Company has been incorporated and is about to build a big gas and coke plant at Geneva or Waterloo, N. Y., which will supply gas to several towns.

The Board of Trade, Meridian, Miss., has accepted a proposition of the promoters of the Memphis & Gulf Railroad to run the line to that place and locate the shops there.

It is rumored that a building, 500 feet long, will be constructed at Auburn, N. Y., for some business in connection with the Columbian Cordage Company, of that place.

The contract has been let to build an addition to one of the buildings of the Bradley & Hubbard Manufacturing Company, gas fixtures, bronze goods, etc., Meriden, Conn.

The Howard Clay Manufacturing Company, recently organized in Baltimore, expects to build a plant at Savage, Md. Robert W. Lyle, of New York, is consulting engineer.

It is reported that E. Rebouiln, Fils & Cie., glaces, fruits, etc., New York city, have been negotiating to purchase a large plant at Elizabeth, N. J., to use for making tinware.

Cramp & Co., contractors, Philadelphia, have posted plans for estimates for a new foundry and machinery building at Eddystone, Pa., for the Valentine Engineering Company.

The Plainfield Tool & Equipment Company, organized by Joseph Loughead *et al.* will establish a plant at Plainfield, N. J., to make machine tools, special machinery, punches, dies, etc.

A large concern, which manufactures saw filing machinery, will probably move to Niles, Mich., from Chicago, and occupy the second floor of the Garden City Fan Company's plant at Niles.

A company is being formed by Chas. Sanford to manufacture a coffin or casket handle at Wheeling, W. Va. He also proposes to float a company to make a patent electric light globe.

The Hudson Motor Vehicle Company, capitalized stock $150,000, is being organized at Hudson, Mich., to manufacture automobiles. Among the directors are Charles Kefuss and E. E. Cole.

A 40x100-foot addition to the plant of the Cornwall & Patterson Manufacturing Company, piano hardware, Bridgeport, Conn., to be used as a polishing room, has been contracted for.

The Patchogue Manufacturing Company, lace manufacturer, Patchogue, L. I., N. Y., is understood to have in view the erection of a new electric power-house and the addition of many looms.

The Randle Machinery Company, Cincinnati, O., manufacturer of injectors and machinery, will erect a $20,000 plant on Power street, Cumminsville, fronting 300 feet on the C., H. & D.

The Fuller Cotton Gin Company will establish a large factory in Memphis, Tenn., to manufacture the Fuller needle gin. The plant will be lighted and operated with electricity. The capacity will be about 1,000 gins per year. Other machinery, such as feeders, condensers and elevators may be made. The company has an office at 7 Monroe street, Memphis.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Grant. Gears. See upper corner, page 62.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks., Waltham, Mass.

Patterns.—Cincinnati Pat. Wks., Cincin., O.

Inventions developed. G. M. Mayer, M. E., Monadnock Block, Chicago, Ill.

Dies and Diemaking, 100 pages $1.00, post paid. J. L. Lucas, Bridgeport, Conn.

Wanted—Improvements in grinding machinery. Address Box 1435, Providence, R. I.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Automatic machinery designed and constructed by the Wellman Sole Cutting Machine Co., Medford, Mass.

Wanted—Competent managers, superintendents and foremen. James Brady, Room J, 26th Floor, 220 Broadway, New York.

Wanted—A set of working drawings of standard Corliss engines of 150 to 200 H.P. Address, with price, Box 195, AMER. MACH.

Practical brass molder, starting business near New York, would like to hear from firms desiring good work at reasonable prices. "Electric," care AMERICAN MACHINIST.

Wanted—Short contributions by practical power plant engineers for a publication for steam engineers; illustrated when possible. Technical Publishing Co., Burns Bldg., Detroit, Mich.

Machinists and Engineers—Simple movement of the slide instantly answers all problems in mathematics; figuring unnecessary; mastered easily; send for free booklet. James Lawlor, Herald Bldg., Fall River, Mass.

Wonderful Discovery.—I will tell you how to harden any form of tool, in water, and guarantee it not to crack. Send 25 cents in silver. Satisfaction guaranteed, or money returned. Gus. Lindstrom, 3449 Wabash ave., Chicago, Ill.

Wanted—By a first-class mechanic, a mechanic or a good man to go on the road, to

sell or manufacture with me a patent friction indicator; large demand; good profit; must have some capital; not less than $1,000 to start with; no agents. Address "Mechanic," care AMERICAN MACHINIST.

Machine and Steam Specialties wanted.—Advertiser is constantly in touch with largest plants in Pittsburg district, and is desirous of increasing his line in new and special machinery; nothing but a strictly meritorious article will be considered. Room 414, Westinghouse Building, Pittsburg, Pa.

For Sale.

For Sale, Cheap—One paid-up, unused, complete mechanical-electrical scholarship in the Scranton Schools. P. O. Box 763, Trenton, N. J.

For Sale—50 horse-power Miller improved gas engine; want to sell to make room for 100 horse-power engine; deliver in six weeks. The Ohio Knife Co., 9th st. and McLean ave., Cincinnati, O.

For Sale—Branch of machine tool line, well established 9 years, with domestic and foreign agencies, separate catalogs, etc., in machine tool center of the West; object, specializing. Address "Chance," care AMER. MACHINIST.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. State mentioned indicates present address of advertiser.

Situations Wanted.

INDIANA.

Designer, of 12 years' experience in engines, steam pumps and boiler work. Box 184, A. M.

NEW JERSEY.

Draftsman; 2 years' practical experience on details and plans of car trucks. Box 196, AMERICAN MACHINIST.

NEW YORK.

Machine designer, etc., wants position. Address Box 63, AMERICAN MACHINIST.

Experienced mechanical draftsman wants position. Box 188, AMERICAN MACHINIST.

Experienced engine superintendent wishes to make change; erecting or selling. Address Box 187, AMERICAN MACHINIST.

General foreman, responsible man, up-to-date mechanic, experienced in high-class automatic and interchangeable machinery, is open for engagement. Box 194, AMER. MACH.

Wanted—Position as superintendent or manager, by an up-to-date man; 18 years' experience; understands the business thoroughly from designer to foundry; have handled men up to 1,500; best references. S. F. C., care AMERICAN MACHINIST.

Mechanical engineer, 20 years' business and technical experience, power plant work a specialty, resourceful, of proven executive ability, will change to position giving better opportunity for advancement; willing to go anywhere. Box 183, AMERICAN MACHINIST.

An experienced man (30) desires a position as superintendent with a firm employing 150 to 200 men and manufacturing medium weight foundry and machine shop products; a man able to get out work economically and quickly and handle men successfully. Box 190, AMERICAN MACHINIST.

OHIO.

Wanted—Situation as superintendent of machine shop, by a man with practical experience in modern methods and discipline. Address Box 147, AMERICAN MACHINIST.

PENNSYLVANIA.

Technical graduate desires to change position. Box 191, AMERICAN MACHINIST.

Position as foreman or superintendent; A1 references. Box 168, AMER. MACHINIST.

Machinist, toolmaker and designer desires responsible position; references. Box 169, AMERICAN MACHINIST.

Mechanical draftsman, technical graduate, wants position in automobile factory in Middle West. Box 136, AMER. MACHINIST.

A thoroughly practical mechanic wants position as superintendent or general foreman of jobbing shop; 16 years' experience; best reference. Address Box 160, AM. MACH.

Mechanical engineer, experienced in designing and superintending manufacture locomotives and general machinery, furnaces, structural bridges, etc., is open for permanent engagement; salary $5,000. Address Box 186, AMERICAN MACHINIST.

RHODE ISLAND.

Position as foreman in drilling department, in large shop preferred, by up-to-date man; one that knows the business; a hustler. Address Box 185, AMERICAN MACHINIST.

Help Wanted.

CANADA.

Wanted—Four first-class screw machine operators; state wages expected and experience. Box 148, AMERICAN MACHINIST.

Wanted—First-class mechanic as speed boss; one who is thoroughly familiar with the capacity and the rate of speed at which all kinds of machine tools should run and the maximum cut they could take; must be thoroughly posted on modern and up-to-date methods. Apply to Canadian General Electric Company, Limited, Peterborough, Canada.

CONNECTICUT.

Wanted—Machinists; first-class men will have steady work and satisfactory pay. U. S. Rapid-Fire Gun & Power Co., Derby, Conn.

ILLINOIS.

Wanted—By Chicago manufacturing company, two first-class metal patternmakers; state age and experience. Box 173, AM. M.

Wanted—By Chicago electrical company, graduate electrical engineer, experienced in testing and assembling dynamos and motors; must be capable of taking charge of department; state age, school and where and when employed. Box 172, AMERICAN MACHINIST.

INDIANA.

Machine shop foreman wanted; must be thoroughly competent; permanent position; good wages. Address Box 273, Indianapolis, Ind.

MASSACHUSETTS.

Wanted—Machinist for lathe and milling work, also young man for office work, also toolmaker for cutter work. Apply at Boston Gear Works, Boston, Mass.

Engine designer, of wide experience, capable of developing a line of high-speed steam engines, wanted to take responsible charge of the drafting and designing department of a large and well-known New England firm; a permanent and growing position is open to a man of first-class executive and technical ability. Address Box 181, AMER. MACHINIST.

Wanted—By a concern in Eastern Massachusetts, building and manufacturing automatic machinery, with a growing business, a young man with a technical education and about 5 years' practical shop experience in this line and willing to work hard for advancement; send references as to character and ability. Box 161, AMERICAN MACHINIST.

MICHIGAN.

Wanted—Foreman for manufacture of fine, light machinery; factory employing 50 men; state salary demanded. Address Box 450, Lansing, Mich.

NEW HAMPSHIRE.

Lathe, planer and erecting floor men; give experience and references. Box 123, AM. M.

Wanted—First-class bronze molder and mixer in small shop, on heavy work. Address, stating experience, wages, etc., Box 178, A. M.

NEW JERSEY.

Wanted—First-class machinists, in city near Philadelphia; steady work and good pay. The Reeves Engine Co., Trenton, N. J.

Wanted—Lathe and planer hands for night work on heavy machine tool work; good wages to good men. Apply to The Pond Machine Tool Company, Plainfield, N. J.

NEW YORK.

Wanted—Two draftsmen on detail design, light locomotives. Gibbs Eng. & Mfg. Co., 8 Bridge st., New York.

Wanted—First-class die and tool makers. Address, giving age and reference, General Electric Company, Schenectady, N. Y.

Wanted—Two good patternmakers on general pattern work; shop in Jersey City; state experience, reference and salary expected. "Pattern Maker," care AMER. MACHINIST.

Wanted—A competent mechanical draftsman and designer for engine and air compressor work; in applying state age, past experience and salary expected. Box 179, A. M.

Toolmakers.—Wanted—Men capable of giving perfect alignments and best results on watch lathe, planer, milling machine and lathe, in a well-equipped nine-hour shop in the country. Apply Monday, April 27, from 11 A. M. to 4 P. M., at the S. S. White Dental Mfg. Co., Nos. 5 and 7 Union Square, New York.

Machinists wanted for floor or vise work, by a manufacturing concern now employing 275 men; factory located one hour's ride from New York city; wages $2.50 per day of 9 hours; open shop; no labor troubles past or present; none but sober and industrious men wanted; state age, nationality and experience for past 5 years. Box 151, AM. M.

Wanted—Mechanical engineer, technical graduate (Cornell or M. I. T. preferred), with at least 5 years' practical experience in designing and constructing light automatic machinery, by manufacturing company employing about 600 hands, to aid in development mechanical processes; company considers the field large and wants really first-class man who can earn good salary; state experience fully. Box 192, AMERICAN MACHINIST.

OHIO.

Wanted—Lathe hands, planer hands, vise hands, milling machine hands; good wages and steady work. Apply to the Harris Automatic Press Company, Niles, O.

Wanted—Two or three first-class machinists at once; steady employment; good wages; state whether union or non-union man. Box 314, Youngstown, O.

Wanted—Toolmaker familiar with jigs and fixtures for milling machines and Gisholt machines in shop building power transmission machinery. Address, with references, Box T, Cleveland, O.

PENNSYLVANIA.

Lathe men, bench and vise hands wanted. Apply Searchmont Automobile Co., Trainer, Pa.

Wanted—Several all-around machinists on paper mill machinery; give age and experience. Address Downington Mfg. Co., East Downington, Pa.

Wanted—First-class designers for machine tool and special work; positions permanent; state experience and salary desired. Box 164, AMERICAN MACHINIST.

Machinists—First-class lathe men and engine builder; steady work; permanent situations to right men. Call or address Keystone Driller Co., Beaver Falls, Pa.

Wanted—First-class foreman for machine shop; must have experience in building machine tools and interchangeable work; state experience and salary desired. Box 165, AMERICAN MACHINIST.

Wanted—A first-class man for our assembling department on brass valves, also first-class man as inspector of brass goods, such as valves, lubricators and fittings; state age and experience. Address Box 180, AMER. MACH.

We are constantly increasing the scope of our work, and invite application for positions from first-class patternmakers, molders and machinists; we always have vacancies. Address The Westinghouse Machine Company, East Pittsburgh, Pa.

Wanted—Superintendent for a growing plant manufacturing tools and employing 100 men; factory is new and has modern equipment and ideas; applicant must have mechanical ability, energy, experience and executive ability. Box 193, AMERICAN MACHINIST.

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Buffalo Forge Co., Buffalo, N. Y.
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Dreses Mach. Tool Co., Cincin., O.
Fairbanks Co., New York.
Fosdick Mach. Tool Co., Cincin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Mueller Mach. Tool Co., Cincin., O.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Prentiss Tool & Supply Co., New York.

Drilling Machines, Turret

Niles Tool Works Co., New York.
Quint, A. D., Hartford, Conn.
Vanderbeek Tool Works, Hartford, Conn.

Drilling Machines, Upright

American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Barr, H. G., Worcester, Mass.
Bement, Miles & Co., New York.
Blaisdell & Co., P., Worcester, Mass.
Brown & Zortman Mchry. Co., Pittsburg, Pa.
Cincinnati Mach. Tool Co., Cin., O.
Davis Mach. Co., W. P., Rochester, N. Y.
Fairbanks Co., New York.
Fosdick Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Niles Tool Works Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Sibley & Ware, South Bend, Ind.
Washburn Shops, Worcester, Mass.
Whitney Mfg. Co., Hartford, Conn.
Woodward & Rogers Co., Hartford, Conn.

Drills, Center

Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Providence, R. I.

Drills, Rail

Bement, Miles & Co., New York.
Niles Tool Works Co., New York.

Drills, Ratchet

Parker Co., Chas., Meriden, Ct.
Pratt & Whitney Co., Hartford, Conn.

Dynamos

C & C Electric Co., New York.
Christensen Engineering Co., Milwaukee, Wis.
Commercial Electric Co., Indianapolis, Ind.
Crocker-Wheeler Electric Co., Ampere, N. J.
Eck Dynamo & Motor Co., Belleville, N. J.
General Elec. Co., New York.
Jantz & Leist Elec. Co., Cincin., O.
Mechanical Appliance Co., Milwaukee, Wis.
Milwaukee Elec. Co., Milwaukee, Wis.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Roth Bros & Co., Chicago, Ill.
Sprague Elec. Co., New York.
Storey Motor & Electric Co., Harrison, N. J.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.

Electrical Supplies

Commercial Electric Co., Indianapolis, Ind.
General Elec. Co., New York.
Milwaukee Elec. Co., Milwaukee, Wis.
Storey Motor & Electric Co., Harrison, N. J.
Triumph Electric Co., Cincin., O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Elevators

Albro-Clem Elevator Co., Philadelphia, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Howard Iron Wks., Buffalo, N. Y.
Morse, Williams & Co., Phila., Pa.

Emery Wheels

See Grinding Wheels.

Enclosures, Tool-room

Merritt & Co., Philadelphia, Pa.

Engines, Automobile

Olds Motor Works, Lansing, Mich.

Engines, Gas and Gasoline

Backus Water Motor Co., Newark, N. J.
Foos Gas Eng. Co., Springfield, O.
Middletown Mach. Co., Middletown, O.
Mietz, August, New York.
National Engine Co., Rockford, Ill.
New Era Iron Wks., Dayton, O.
Olds Motor Wks., Lansing, Mich.
Stover Engine Works, Freeport, Ill.
Struthers-Wells Co., Warren, Pa.

Engines, Steam

Buffalo Forge Co., Buffalo, N. Y.
Frick Co., Waynesboro, Pa.
Rand Drill Co., New York.
Struthers-Wells Co., Warren, Pa.

Exhaust Fans

Buffalo Forge Co., Buffalo, N. Y.

Exhaust Heads

Burt Mfg. Co., Akron, O.

Fans, Electric

General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Feed Water Heater and Purifier

Hawley Down Draft Furnace Co., Chicago, Ill.

Files and Rasps

Barnett Co., G. & H., Phila., Pa.
Hammacher, Schlemmer & Co., New York.
Nicholson File Co., Provi., R. I.
Patterson, Gottfried & Hunter, Ltd., New York.

Filing Machines

Cochrane-Bly Mach. Co., Rochester, N. Y.

Fillers, Oil Can

The Winkley Co., Hartford, Conn.

Filters, Oil

Burt Mfg. Co., Akron, O.

Fittings, Steam

Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Jenkins Bros., New York.
Lunkenheimer Co., Cincinnati, O.
Walworth Mfg. Co., Boston, Mass.

Flexible Shafts

Chicago Flexible Shaft Co., Chicago, Ill.

Forges

Buffalo Forge Co., Buffalo, N. Y.
Miner & Peck Mfg. Co., New Haven, Conn.
Patterson, Gottfried & Hunter, Ltd., New York.

Forgings, Drop

Billings & Spencer Co., Hartford, Conn.
Miner & Peck Mfg Co., New Haven, Conn.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic

Wyman & Gordon, Worcester, Mass.

Forgings, Steel

Hay-Budden Mfg. Co., Brooklyn, N. Y.
Pittsburg Shear Knife & Mach. Co., Pittsburg, Pa.
Wyman & Gordon, Worcester, Mass.

Foundry Furnishings

Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Philadel., Pa.
Whiting Foundry Equip. Co., Harvey, Ill.

Furnaces, Coal and Oil

Buffalo Forge Co., Buffalo, N. Y.
Hawley Down Draft Furnace Co., Chicago, Ill.
Jacobson Mach. Mfg. Co., Warren, Pa.
Obermayer Co., S., Cincinnati, O.

Furnaces, Gas

Am. Gas Furnace Co., N. Y. City.
Chicago Flexible Shaft Co., Chicago, Ill.

Furniture, Machine Shop

New Britain Mach. Co., New Britain, Conn.

Gages, Recording

Bristol Co., Waterbury, Conn.

Gages, Standard

Brown & Sharpe Mfg. Co., Providence, R. I.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gages, Steam

Crosby Steam Gage & Valve Co., Boston, Mass.

Gear Cutting Machinery

Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Newton Mch. Tool Wks., Phil., Pa.
Niles Tool Works Co., New York.
Whiton Machine Co., D. E., New London, Conn.

Gears, Cut

Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Works, Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Fawcus Mach. Co., Pittsburgh, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott, Cleveland, O.
Messmer Mfg. Co., Ferd., St. Louis, Mo.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Philadelphia Gear Works, Philadelphia, Pa.
Sawyer Gear Wks., Cleveland, O.
Simonds Mfg. Co., Pittsburgh, Pa.

Gears, Molded

Caldwell & Son Co., H. W., Chicago, Ill.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cincin., O.

Gears, Rawhide

Chicago Raw Hide Co., Chicago, Ill.
Fawcus Mch. Co., Pittsburgh, Pa.
Horsburgh & Scott, Cleveland, O.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.

Gears, Worm

Albro-Clem Elevator Co., Philadelphia, Pa.
Fawcus Mach. Co., Pittsburgh, Pa.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburgh, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.

Graphite

Dixon Crucible Co., Jos., Jersey City, N. J.
Lubriphite Co., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Center

Heald & Son, L. S., Barre, Mass.
Hisey-Wolf Mach. Co., Cincin., O.

Grinders, Cock

Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter

Adams Co., Dubuque, Iowa.
Automatic Mach. Co., Greenfield, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Machine Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.
Woodward & Rogers Co., Hartford, Conn.

Grinders, Disc

Besly & Co., Chas. H., Chicago, Ill.
Gorton Mach. Co., Geo., Racine, Wis.
Iroquois Mach. Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.

Grinders, Drill

Gorton Mach. Co., Geo., Racine, Wis.
Heald & Son, L. S., Barre, Mass.
Standard Tool Co., Cleveland, O.
Washburn Shops, Worcester, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Tool

Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Barr, H. G., Worcester, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Diamond Mach. Co., Provi., R. I.
Gisholt Mach. Co., Madison, Wis.
Landis Tool Co., Waynesboro, Pa.
Modern Tool Co., Erie, Pa.
Northampton Emery Wheel Co., Leeds, Mass.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, O.
Throop Perforating Co., Buffalo, N. Y.
Whitney Mfg. Co., Hartford, Ct.

Grinding Machines
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Fairbanks Co., New York.
Falkenau-Sinclair Co., Phila., Pa.
Goodell-Pratt Co., Greenfield, Mass.
Gorton Mach. Co., Geo., Racine, Wis.
Greenfield Mach. Co., Greenfield Mass.
Hill, Clarke & Co., Boston, Mass.
Hisey-Wolf Mch. Co., Cincin., O.
Iroquois Mach. Co., New York.
Landis Tool Co., Waynesboro, Pa.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Mechanical Appliance Co., Milwaukee, Wis.
Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.
Norton Grinding Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, Ohio.
Throop Perforating Co., Buffalo, N. Y.
Washburn Shops, Worcester, Mass.
Webster & Perks Tool Co., Springfield, O.
Wilmarth & Morman Co., Grand Rapids, Mich.
Woodward & Rogers Co., Hartford, Conn.

Grinding Wheels
Builders' Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Diamond Mach. Co., Provi., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Whitney Mfg. Co., Hartford, Conn.

Gun Barrel Machinery
Bement, Miles & Co., New York.
Diamond Mach. Co., Provi., R. I.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Reed Co., F. E., Worcester, Mass.

Hack Saw Blades and Frames
Diamond Saw & Stamping Wks., Buffalo, N. Y.
Goodell-Pratt Co., Greenfield, Mass.
Hammacher, Schlemmer & Co., New York.
Millers Falls Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Starrett Co., L. S., Athol, Mass.
West Haven Mfg. Co., New Haven, Conn.

Hack Saws, Power
Diamond Saw & Stamping Wks., Buffalo, N. Y.
Hoefer Mfg. Co., Freeport, Ill.
Millers Falls Co., New York.
West Haven Mfg. Co., New Haven, Conn.

Hammers, Drop
Bement, Miles & Co., New York.
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Miner & Peck Mfg. Co., New Haven, Conn.
Mossberg & Granville Mfg. Co., Providence, R. I.
Perkins Mach. Co., Boston, Mass.

Hammers, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Dallett & Co., Thos. H., Phila., Pa.
Phila. Pneu. Tool Co., Philadelphia, Pa.
Railway Appliances Co., Chicago, Ill.
Rand Drill Co., New York.
Standard Ry. Equip. Co., St. Louis, Mo.

Hammers, Power
Scranton & Co., The, New Haven, Conn.

Hammers, Steam
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Chambersburg Engr. Co., Chambersburg, Pa.
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Pittsburg Shear Knife & Mach. Co., Pittsburg, Pa.

Heating and Ventilating Apparatus
Buffalo Forge Co., Buffalo, N. Y.

Heating Machines, Automatic
Am. Gas Furnace Co., New York.

Hoisting and Conveying Machinery
Brown Hoisting Mchry. Co., New York.
Caldwell & Son Co., H. W., Chicago, Ill.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

Hoists, Electric
C & C Electric Co., New York.
Hunt Co., C. W., West New Brighton, N. Y.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger, Milwaukee, Wis.
Sprague Electric Co., New York.

Hoists, Hand
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Northern Engineering Wks., Detroit, Mich.
Rand Drill Co., New York.

Igniters, Gas Engine
Dayton Electrical Mfg. Co., Dayton, O.

Indicators, Speed
Starrett Co., L. S., Athol, Mass.

Indicators, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Injectors
Lunkenheimer Co., Cincinnati, O.
Sellers & Co., Wm., Phila., Pa.

Inspection and Tests
Hunt Co., Robt. W., Chicago, Ill.

Instruction Schools
See Schools, Correspondence.

Insurance, Boiler
Hartford Steam Boiler Insp. & Ins. Co., Hartford, Conn.

Jacks, Hydraulic
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Jack Planer
Armstrong Bros. Tool Co., Chicago, Ill.

Key Seaters
Baker Bros., Toledo, O.
Bement, Miles & Co., New York.
Chattanooga Mchry. Co., Chattanooga, Tenn.
Davis Mach. Co., W. P., Rochester, N. Y.
Matts & Merrill, Saginaw, Mich.
Whitney Mfg. Co., Hartford, Conn.

Keys, Machine
Standard Gauge Steel Co., Beaver Falls, Pa.
Whitney Mfg. Co., Hartford, Ct.

Knives, Solid Steel Shear
Pittsburg Shear Knife & Mach. Co., Pittsburg, Pa.

Lamps, Arc
General Electric Co., N. Y. City.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Lathe Attachments
National Machine Tool Co., Cincinnati, O.

Lathe Dogs
Armstrong Bros. Tool Co., Chicago, Ill.
Besly & Co., Chas. H., Chicago, Ill.
Le Count, Wm. G., So. Norwalk, Conn.
Pratt & Whitney Co., Hartford, Conn.
Tindel-Morris Co., Eddystone, Pa.

Lathes
Affleck, Geo. E., New York.
American Tool Wks. Co., Cin., O.
Automatic Mach. Co., Greenfield, Mass.
Barker & Co., Wm., Cincin., O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bement, Miles & Co., New York.
Blaisdell & Co., P., Worcester, Mass.
Bradford Mach. Tool Co., Cin., O.
Brown & Zortman Mchry. Co., Pittsburg, Pa.
Bullard Mach. Tool Co., Bridgeport, Conn.
Davis Mach. Co., W. P., Rochester, N. Y.
Diamond Machine Co., Prov., R. I.
Draper Mach. Tool Co., Worcester, Mass.
Fairbanks Co., New York.
Fay & Scott, Dexter, Me.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Greaves, Klusman Co., Cincin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mch. Tool Co., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Milwaukee Machine Tool Co., Milwaukee, Wis.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Reed Co., F. E., Worcester, Mass.
Schumacher & Boye, Cincinnati, Ohio.
Sebastian Lathe Co., Cincin., O.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Washburn Shops, Worcester, Mass.

Lathes, Automatic Screw-Threading
Automatic Machine Co., Bridgeport, Conn.

Lathes, Bench
Faneuil Watch Tool Co., Boston, Mass.
Loop-Lock Mach. Co., Waltham, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Lathes, Boring
Streit Mach. Co., A., Cincin., O.

Letters, Pattern
Brim, A. W., Seneca Falls, N. Y.
Butler, A. G., N. Y. City.

Levels
Mass. Tool Co., Greenfield, Mass.
Starrett Co., L. S., Athol, Mass.

Lockers, Clothes
Merritt & Co., Philadelphia, Pa.
Narragansett Mach. Co., Providence, R. I.

Locomotives, Shop
Hunt Co., C. W., West New Brighton, N. Y.

Lubricants
Besly & Co., Chas. H., Chicago, Ill.
Dixon Crucible Co., Jos., Jersey City, N. J.
Lubriphite Co., Jersey City, N. J.

Lubricators
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lubriphite Co., Jersey City, N. J.
Lunkenheimer Co., Cincinnati, O.

Machine Screws
Atlantic Mach. Screw Co., Boston, Mass.
Worcester Mach. Screw Co., Worcester, Mass.

Machinery Builders, Special
American Fdry. & Mach. Co., Hanover, Pa.
Blanchard Mach. Co., The, Boston, Mass.
Eclipse Mach. Co., Cleveland, O.
Fawcus Mch. Co., Pittsburgh, Pa.
Hart, Fredk., Poughkeepsie, N. Y.
Hoefer Mfg. Co., Freeport, Ill.
Pratt & Whitney Co., Hartford, Conn.
Simonds Mfg. Co., Pittsburgh, Pa.
Wade Mach. Works, Walter H., Boston, Mass.
Woodward & Rogers Co., Hartford, Conn.

Machinists' Small Tools
Besly & Co., Chas. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
McCrosky & Huber, Cincinnati, O.
Mass. Tool Co., Greenfield, Mass.
Patterson, Gottfried & Hunter, Ltd., New York.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Provi., R. I.
Standard Tool Co., Cleveland, O.
Starrett Co., L. S., Athol, Mass.

Machinists' Supplies
Hammacher, Schlemmer & Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.

Mandrels, Expanding
Nicholson & Son, W. H., Wilkesbarre, Pa.

Mandrels, Solid
Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Measuring Machines
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.

Metal, Bearing
Besly & Co., Chas. H., Chicago, Ill.
Patterson, Gottfried & Hunter, Ltd., New York.
Phosphor Bronze Smelting Co., Philadelphia, Pa.

Metal, Perforated
Throop Perforating Co., Buffalo, N. Y.

Micrometer Calipers
Brown & Sharpe Mfg. Co., Providence, R. I.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

Milling Attachments
The Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Kempsmith Mfg. Co., Milwaukee, Wis.
Whitney Mfg. Co., Hartford, Conn.

Milling Machines, Bench
Faneuil Watch Tool Co., Boston, Mass.
Hill, Clarke & Co., Boston, Mass.
Loop-Lock Mach. Co., Waltham, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Horizontal
Adams Co., Dubuque, Iowa.
Beaman & Smith Co., Prov., R. I.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bement, Miles & Co., New York.
Hendey Mach. Co., Torrington, Ct.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Milling Machines, Plain

American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Fairbanks Co., New York.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Marshall & Huschart Mchry. Co., Chicago, Ill.
McCabe, J. J., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Portable

Underwood & Co., H. B., Philadelphia, Pa.

Milling Machines, Universal

American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Fairbanks Co., New York.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Marshall & Huschart Mchry. Co., Chicago, Ill.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Vertical

Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Garvin Mach. Co., New York.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mch. Tool Works, Philadelphia, Pa.
Niles Tool Works Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Pratt & Whitney Co., Hartford, Conn.
Quint, A. D., Hartford, Conn.

Milling Tools, Adjustable

Geometric Drill Co., New Haven, Conn.
Rogers, Boat, Gage & Drill Wks., John M., Gloucester City, N. J.

Molding Machines

Adams Co., The, Dubuque, Iowa.
American Foundry & Mach. Co., Hanover, Pa.
Tabor Mfg. Co., Philadelphia, Pa.
Webster & Perks Tool Co., Springfield, O.

Motors, Electric

C & C Electric Co., New York.
Christensen Engr. Co., Milwaukee, Wis.
Commercial Electric Co., Indianapolis, Ind.
Crocker-Wheeler Co., Ampere, N.J.
Eck Dynamo & Motor Wks., Belleville, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Mechanical Appliance Co., Milwaukee, Wis.
Milwaukee Elec. Co., Milwaukee, Wis.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Roth Bros. & Co., Chicago, Ill.
Sprague Electric Co., New York.
Storey Motor & Electric Co., Harrison, N. J.

Motors, Electric—*Continued*

Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Name Plates

Franklin Mfg. Co., Syracuse, N. Y.
Turner Brass Works, Chicago, Ill.

Nut Tappers

See Bolt and Nut Machinery.

Oil Cups and Covers

Bay State Stamping Works, Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.
Tucker, W. W. & C. F., Hartford, Conn.
The Winkley Co., Hartford, Conn.

Oils

Besly & Co., Chas. H., Chicago, Ill.
Harris Oil Co., A. W., Provi., R. I.

Oils, Slushing

Harris Oil Co., A. W., Provi., R. I.

Oil Stones

Pike Mfg. Co., Pike Station, N. H.

Packing, Steam Joint

Jenkins Bros., New York.
N. Y. Belting & Packing Co., New York.
Peerless Rubber Mfg. Co., New York.

Pans, Lathe

New Britain Mch. Co., New Britain, Conn.

Patents

Baldwin, Davidson & Wight, Washington, D. C.
Straley, Hasbrouck & Schloeder, New York.

Pattern Shop Machinery

Baker Bros., Toledo, O.
Brown & Zortman Mchry. Co., Pittsburg, Pa.
Fairbanks Co., New York.
Fay & Scott, Dexter, Me.
Greaves, Klusman & Co., Cin., O.
Prentiss Tool & Supply Co., New York.
Washburn Shops, Worcester, Mass.

Pencils

Keuffel & Esser Co., New York.

Phosphor Bronze

Phosphor Bronze Smelting Co., Philadelphia, Pa.

Pinion Cutters

Loop-Lock Mach. Co., Waltham, Mass.

Pipe and Fittings

Crane Co., Chicago, Ill.

Pipe Cutting and Threading Machines

Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Curtis & Curtis Co., Bridgeport, Conn.
Merrell Mfg. Co., Toledo, O.
Reed Mfg. Co., Erie, Pa.
Saunders' Sons, D., Yonkers, N. Y.
Wells Bros. Co., Greenfield, Mass.

Pipe Fitters' Tools

Cleveland Twist Drill Co., Cleveland, O.
Saunders' Sons, D., Yonkers, N. Y.
Standard Tool Co., Cleveland, O.

Planers

Affleck, Geo. E., New York.
American Tool Wks. Co., Cin., O.
Belmer Mach. Tool Co., Cin., O.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del
Cincinnati Planer Co., Cincin., O.
Detrick & Harvey Mch. Co., Baltimore, Md.
Fairbanks Co., New York.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Gray Co., G. A., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Niles Tool Works Co., New York.

Planers—*Continued*

New Haven Mfg. Co., New Haven, Conn.
Pond Mach. Tool Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Wm., Phila., Pa.
Whitcomb Mfg. Co., Worcester, Mass.
Woodward & Powell Planer Co., Worcester, Mass.

Planers, Bench

Bartlett, E. E., Boston, Mass.

Planers, Portable

Underwood & Co., H. B., Philadelphia, Pa.

Planers, Rotary

Bement, Miles & Co., New York.
Cleveland Punch & Shear Works, Cleveland, O.
Newton Mach. Tool Wks., Philadelphia, Pa.
Pond Mach. Tool Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Presses, Hand

Elmes Engr. Works, Chas. F., Chicago, Ill.
Perkins Mach. Co., So. Boston, Mass.

Presses, Hydraulic

Watson-Stillman Co., New York.

Presses, Power

Automatic Mach. Co., Bridgeport, Conn.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Chambersburg Engr. Co., Chambersburg, Pa.
Elmes Engr. Works, Chas. F., Chicago, Ill.
Fairbanks Co., New York.
Mossberg & Granville Mfg. Co., Providence, R. I.
Perkins Mach. Co., So. Boston, Mass.
Prentiss Tool & Supply Co., New York.

Profilers

Garvin Mach. Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Pulleys

Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Federal Mfg. Co., Cleveland, O.
Howard Iron Wks., Buffalo, N. Y.
Oneida Steel Pulley Co., Oneida, N. Y.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.
The Xylotite Co., Cincinnati, O.

Pulleys, Friction Cone

Evans Friction Cone Co., Boston, Mass.

Pulleys, Speed Changing

Speed Changing Pulley Co., Indianapolis, Ind.

Pulley Turning and Boring Machines

Harrington, Son & Co., Edwin, Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Streit Mach. Co., A., Cincin., O.

Pumps, Hydraulic

Elmes Engr. Works, Chas. F., Chicago, Ill.
Watson-Stillman Co., New York.

Punches, Hydraulic

Bement, Miles & Co., New York.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Punches, Power

Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cincinnati Punch & Shear Co., Cincinnati, O.
Cleveland Punch & Shear Wks., Co., Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Perkins Mach. Co., S. Boston, Mass.

Rack Cutting Machines

Fellows Gear Shaper Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Reed Co., F. E., Worcester, Mass.

Racks, Cut

Fellows Gear Shaper Co., Springfield, Vt.
Nuttall Co., R. D., Pittsburgh, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.
Standard Gauge Steel Co., Beaver Falls, Pa.

Racks, Tool

New Britain Mach. Co., New Britain, Conn.

Reamers

Cleveland Twist Drill Co., Cleveland, O.
Clough, R. M., Tolland, Conn.
McCrosky & Huber, Cincinnati, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
New Process Twist Drill Co., Taunton, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.

Reaming Stands

Flather Planer Co., Mark, Nashua, N. H.

Rheostats

Cutler-Hammer Mfg. Co., Milwaukee, Wis.

Riveters, Hydraulic

Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Riveters, Pneumatic

Bement, Miles & Co., New York.
Cleveland Pneumatic Tool Co., Cleveland, O.
Philadelphia Pneumatic Tool Co., Philadelphia, Pa.
Railway Appliances Co., Chicago, Ill.
Rand Drill Co., New York.
Standard Ry. Equip. Co., St. Louis, Mo.

Riveting Machines

Bement, Miles & Co., New York.
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Chambersburg Engr. Co., Chambersburg, Pa.
Long & Allstatter Co., Hamilton, Ohio.
Perkins Mach. Co., So. Boston, Mass.

Roller and Ball Bearings

Ball Bearing Co., Philadel., Pa.
Bantam Mfg. Co., Bantam, Conn.
Mossberg & Granville Mfg. Co., Providence, R. I.

Rolling Mill Machinery

Cleveland Punch & Shear Wks., Co., Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Mossberg & Granville Mfg. Co., Providence, R. I.
Pratt & Whitney Co., Hartford, Conn.

Rubber Goods, Mechanical

N. Y. Belting & Packing Co., New York.
Peerless Rubber Mfg. Co., New York.

Rules, Steel

Mass. Tool Co., Greenfield, Mass.
Sawyer Tool Co., Fitchburg, Mass.
Slocomb Co., J. T., Provi., R. I.

Safety Valves, Pop

Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.

Sand Blast Apparatus

Paxson Co., J. W., Philadel., Pa.

Sand Mixing Machines

Obermayer Co., S., Cincinnati, O.

Sawing Machines, Wood

Brown & Zortman Mchry. Co., Pittsburg, Pa.

Sawing Machines, Metal
Cleveland Punch & Shear Works Co., Cleveland, O.
Cochrane-Bly Mach. Works, Rochester, N. Y.
Newton Mach. Tool Works, Philadelphia, Pa.
Pratt & Whitney Co., Hartford, Conn.
West Haven Mfg. Co., New Haven, Conn.

Schools, Correspondence
Amer. School of Correspondence, Chicago, Ill.
Consolidated Schools, N. Y. City.
International Correspond. Schools, Scranton, Pa.

Schools, Technical
State College of Ky., Lexington, Ky.

Screw Machines, Automatic
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Dreses Mach. Tool Co., Cincin., O.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Windsor Mach. Co., Windsor, Vt.

Screw Machines, Hand
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Draper Mach. Tool Co., Worcester, Mass.
Garvin Mach. Co., New York.
Jones & Lamson Mch. Co., Springfield, Vt.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Screw Machinery, Wood and Lag
Baker Bros., Toledo, Ohio.
Cook Co., Asa S., Hartford, Conn.

Screw Plates
Besly & Co., Chas. H., Chicago, Ill.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Card Mfg. Co., S. W., Mansfield, Mass.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Second Hand Machinery
Affleck, Geo. E., New York.
Baird Machy. Co., Pittsburg, Pa.
Bowler & Co., Geo. H., Cleveland, Ohio.
Brown & Zortman Mchry. Co., Pittsburg, Pa.
Carlin Mchry. & Supply Co., Allegheny, Pa.
Fairbanks Co., New York.
Fairbanks Co., Philadelphia, Pa.
Garvin Mch. Co., New York.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mchry. Co., Chicago, Ill.
McCabe, J. J., New York.
Niles-Bement-Pond Co., New York.
Packard Machinery Co., O. L., Chicago, Ill.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Toomey, Frank, Philadelphia, Pa.
Wickes Bros., New York.
Wormer Machy. Co., C. C., Detroit, Mich.

Separators, Magnetic
Sawyer, Ezra, Worcester, Mass.

Shapers
American Tool Wks. Co., Cin., O.
Barker & Co., Wm., Cincinnati, O.
Bement, Miles & Co., New York.
Cincinnati Shaper Co., Cincin., O.
Fairbanks Co., New York.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Gould & Eberhardt, Newark, N. J.
Hendey Mch. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kelly Co., R. A., Xenia, Ohio.
Marshall & Huschart Mchry. Co., Chicago, Ill.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.

Shapers—*Continued*
Perkins Mach. Co., So. Boston, Mass.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Prentiss Tool & Supply Co., New York.
Smith & Mills, Cincinnati, O.
Steptoe Shaper Co., John, Cincinnati, O.

Shears, Power
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cincinnati Punch & Shear Co., Cincinnati, O.
Cleveland Punch & Shear Works, Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Perkins Mach. Co., So. Boston, Mass.

Shears, Rotary
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.
Perkins Mach. Co., So. Boston, Mass.

Shelving, Shop
New Britain Mach. Co., New Britain, Conn.

Slide Rests
Bartlett, E. E., Boston, Mass.
Reed Co., F. E., Worcester, Mass.

Slotters
Baker Bros., Toledo, Ohio.
Barr, H. G., Worcester, Mass.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Garvin Mach. Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.

Sockets and Sleeves
New Process Twist Drill Co., Taunton, Mass.

Sprocket Chains
See Driving Chains.

Stampings, Sheet Steel
Federal Mfg. Co., Cleveland, O.

Stamps, Steel
Schwerdtle Stamp Co., Bridgeport, Conn.

Steel, Machinery
Boker & Co., Hermann, New York.
Patriarche & Bell, New York.
Ward & Son, Edgar T., Boston, Mass.

Steel, Sheet
Federal Mfg. Co., Cleveland, O.
Ward & Son, Edgar T., Boston, Mass.

Steel, Tool
Boker & Co., Hermann, New York.
Firth-Sterling Steel Co., Demmler, Pa.
Patriarche & Bell, New York.
Patterson, Gottfried & Hunter, Ltd., New York.

Stones, Oil
Pike Mfg. Co., Pike Station, N. H.

Straightener, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Swaging Machines
Excelsior Needle Co., Torrington, Conn.
Mossberg & Granville Mfg. Co., Providence, R. I.

Switchboards
C & C Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Tapping Machines and Attachments
Baker Bros., Toledo, O.
The Beaman & Smith Co., Providence, R. I.
Bickford Drill & Tool Co., Cin., O.
Cincinnati Mach. Tool Co., Cincinnati, O.
Errington, F. A., N. Y. City.
Fosdick Mach. Tool Co., Cin., O.

Tapping Machines and Attachments—*Continued*
Garvin Mach. Co., New York.
Geometric Drill Co., New Haven, Conn.
Modern Tool Co., Erie, Pa.
Murray Mfg. Co., Richmond Valley, S. I., N. Y.
Pratt & Whitney Co., Hartford, Conn.
Quint, A. D., Hartford, Conn.
Webster & Perks Tool Co., Springfield, O.
Whitney Mfg. Co., Hartford, Conn.
Woodward & Rogers Co., Hartford, Conn.

Taps, Collapsing
Geometric Drill Co., New Haven, Conn.

Taps and Dies
Besly & Co., Chas. H., Chicago, Ill.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Crane Co., Chicago, Ill.
Geometric Drill Co., New Haven, Conn.
Hammacher, Schlemmer & Co., New York.
Morse Twist Drill & Mach. Co., New Beuford, Mass.
Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.
Webster & Perks Tool Co., Springfield, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Telephone System
Clark Auto. Telephone Switch Board Co., Providence, R. I.

Thread Cutting Tools
Besly & Co., Chas. H., Chicago, Ill.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Tool Holders
Armstrong Bros. Tool Co., Chicago, Ill.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
McCrosky & Huber, Cincinnati, O.

Tools, Small
See Machinists' Small Tools.

Tracing Cloth
Keuffel & Esser Co., New York.
Hardtmuth, L. & C., New York.

Transmission Machinery
Caldwell & Son Co., H. W., Chicago, Ill.
Case Mfg. Co., Columbus, O.
Cresson & Co., Geo. V., Phila., Pa.
Federal Mfg. Co., Cleveland, O.
Link-Belt Engineering Co., Philadelphia, Pa.
National Machine Tool Co., Cincinnati, O.
Oneida Steel Pulley Co., Oneida, N. Y.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.

Trimmers, Wood
Washburn Shops, Worcester, Mass.

Trolleys and Tramways
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Yale & Towne Mfg. Co., New York.

Tubing, Steel
Shelby Steel Tube Co., Pittsburgh, Pa.

Turret Machines
Automatic Mach. Co., Greenfield, Mass.
Bradford Mach. Tool Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Mach. Tool Co., Bridgeport, Conn.
Dreses Mach. Tool Co., Cincin., O.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Gisholt Mch. Co., Madison, Wis.

Turret Machines—*Continued*
Hill, Clarke & Co., Boston, Mass.
Jones & Lamson Mch. Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
Milwaukee Mach. Tool Co., Milwaukee, Wis.
Niles Tool Works Co., New York.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnson Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Turrets, Carriage
Fay & Scott, Dexter, Me.

Twist Drills
Cleveland Twist Drill Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
Morse Twist Drill & M. Co., New Bedford, Mass.
New Process Twist Drill Co., Taunton, Mass.
Patterson, Gottfried & Hunter, Ltd., New York.
Standard Tool Co., Cleveland, O.

Unions, Brass
Nolte Brass Co., Springfield, O.

Universal Joints
Baush Machine Tool Co., Springfield, Mass.
Vanderbeek Tool Wks., Hartford, Conn.
Waterbury Tool Co., Waterbury, Conn.

Valves
See Steam Fittings.

Vises, Drill
Graham Mfg. Co., Provi., R. I.
Hollands Mfg. Co., Erie, Pa.
Jacobson Mach. Mfg. Co., Warren, Pa.

Vises, Metal Workers'
Hammacher, Schlemmer & Co., New York.
Hanna, E. E., Chicago, Ill.
Howard Iron Wks., Buffalo, N. Y.
Jacobson Mach. Mfg. Co., Warren, Pa.
Parker Co., Chas., Meriden, Conn.
Reed Mfg. Co., Erie, Pa.
Walworth Mfg. Co., Boston, Mass.

Vises, Pipe
Curtis & Curtis Co., Bridgeport, Conn.
Saunders' Sons, D., Yonkers, N. Y.
Walworth Mfg. Co., Boston, Mass.

Vises, Planer and Shaper
Cincinnati Planer Co., Cincin., O.
Hendey Mach. Co., Torrington, Ct.
Pratt & Whitney Co., Hartford, Conn.

Vises, Wood Workers'
Hammacher, Schlemmer & Co., New York.
Wyman & Gordon, Worcester, Mass.

Welding Machines
Long & Allstatter Co., Hamilton, Ohio.

Wire-Drawing Machinery
Iroquois Mach. Co., New York.
Mossberg & Granville Mfg. Co., Providence, R. I.

Wire-Forming Machinery
Automatic Mach. Co., Bridgeport, Conn.

Wire-Straightening Machinery
Hoefer Mfg. Co., Freeport, Ill.

Worm Hobbing Machines
Pratt & Whitney Co., Hartford, Conn.

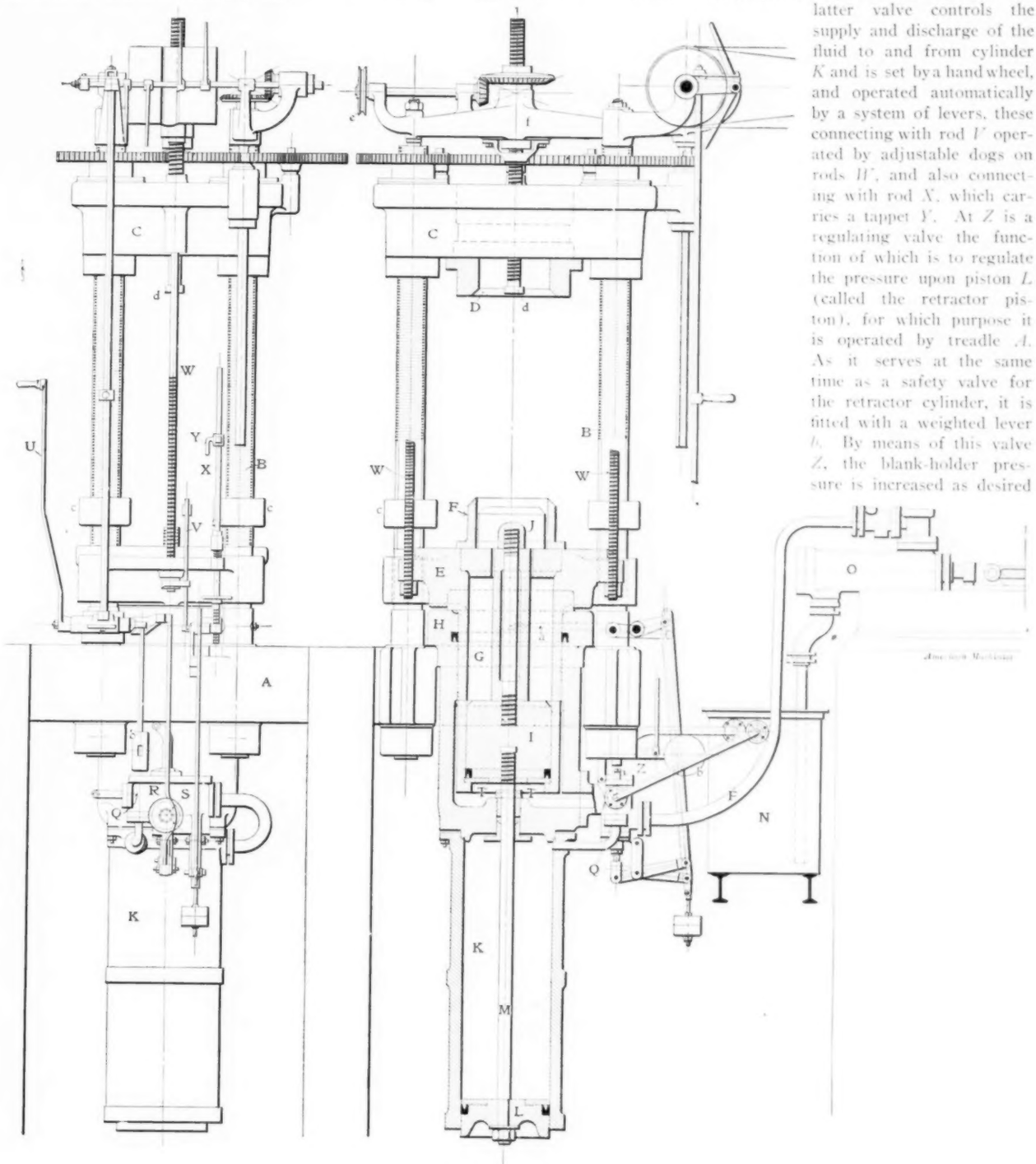
Worm Milling Machines
Cleveland Automatic Mach. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.

Wrenches
Coes Wrench Co., Worcester, Mass.

Wrenches, Drop Forged
Billings & Spencer Co., Hartford, Conn.

Hydraulic Drawing Press.

The accompanying engraving illustrates a powerful hydraulic press which is designed for heavy drawing and other operations of a similar nature, and which is provided with an interesting arrangement of cylinders and piston for operating the blank holder and the drawing punch.



HYDRAULIC DRAWING PRESS.

The base of this press, which is shown at *A*, is mounted on a suitable foundation and provided with four heavy screws *B* which carry the head *C* in which the die *D* is secured. *C* is adjustable up and down by power, four nuts fitting the screws being operated for this purpose by means of gearing which is driven in either direction, in the manner indicated, by the shaft above. The lower plate or bolster *E* carrying the blank holder and adapted to slide up and down on the four screws is mounted on a piston *G* in cylinder *H*. This piston is itself a cylinder in which is fitted another piston *I*, the latter being connected as shown, with the drawing punch *J*. Below cylinder *H* is a cylinder *K*, which is fitted with a piston *L* connected by rod *M* with piston *I*.

At *N* is the reservoir for the liquid and at *O* a two-cylinder belt-driven pump for forcing the liquid through pipe *P* to the valve casing *Q*, and from there to the press. Two valves *R* and *S* are fitted in casing *Q*, the former controlling the supply and discharge of the pressure fluid to and from chamber *T* below pistons *G* and *I*, and being operated by the lever *U*, while the latter valve controls the supply and discharge of the fluid to and from cylinder *K* and is set by a hand wheel, and operated automatically by a system of levers, these connecting with rod *V* operated by adjustable dogs on rods *W*, and also connecting with rod *X*, which carries a tappet *Y*. At *Z* is a regulating valve the function of which is to regulate the pressure upon piston *L* (called the retractor piston), for which purpose it is operated by treadle *A*. As it serves at the same time as a safety valve for the retractor cylinder, it is fitted with a weighted lever *b*. By means of this valve *Z*, the blank-holder pressure is increased as desired without interrupting the operation of the machine.

The press being adjusted for the work in hand and all three pistons being in their lowest position the handle *U* is put in its mid position and the pump started, the

fluid then being forced directly through valve casing Q and back to the reservoir. The controlling lever is then moved to the right and cylinder K begins to fill first (this being the case, however, only when the machine is first used) and all the pistons commence to rise. Piston L lifts the fluid in cylinder K and drives it up under the other pistons, thus accelerating their speed. The pistons rise until the blank to be drawn is gripped tight between holder F and die D, the bolster E then striking against the stop nuts c which relieve the blank of any excess pressure. At the same time the tappet Y lifts the rod X and closes valve S, thus shutting off communication between cylinder K and chamber T, piston I continuing to rise and under increased pressure due to automatic regulation of the pump.

As the punch draws the work to the desired depth in the die, the bottom of the piece strikes a stop rod d (which stop is adjustable through suitable gearing operated by a chain passing over wheel e), frame f and rods W are lifted and valve S is thus opened, communication again being established between chamber T and cylinder K. The lever U, at the same time, is put into mid-position and the pistons descend rapidly; the fluid again fills K, the remainder returning to reservoir N.

If for any reason the punch should stick in the work and prevent the pistons from descending, the controlling lever may be moved to the left; the valves then admit pressure fluid to cylinder K and the pistons are drawn back to their original position.

This press is built by L. Schuler, Goeppingen, Germany.

The Deflection of Beams When Unsymmetrically Loaded.

BY P. P. BREDSTEN.

When figuring the deflection of beams (or shafts) with a single unsymmetrical load, I have found the enclosed diagram handy and time-saving. It is only necessary to solve the formula $\frac{W l^3}{48 E I}$ which gives the deflection of a beam supported at both ends with a single load in the *middle*, or take the same from tables and multiply the result by the correction factor c taken from the diagram. In order to find c the value of $f = \frac{n}{l}$ must be found (see the figure and diagram).

Example: Say, the deflection from formula $\frac{W l^3}{48 E I}$ is found to be .07 and $f = \frac{n}{l} = .3$, then the corresponding value of c given by the curve A is .8. Hence the maximum deflection is:

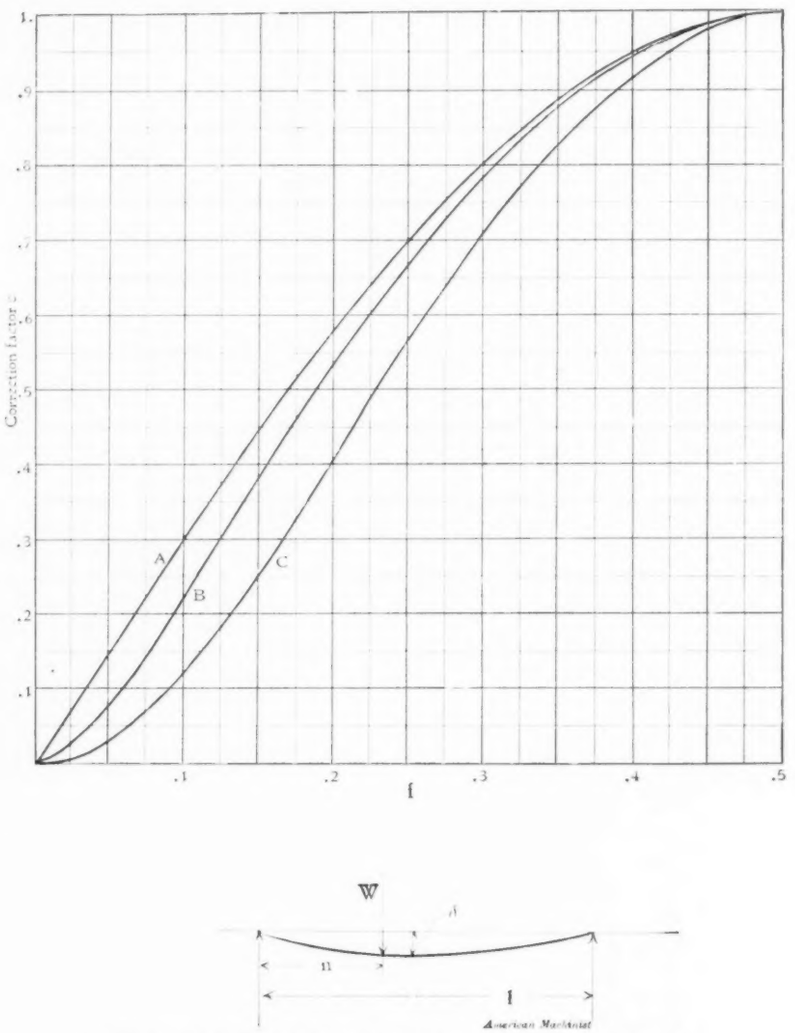
$$d = \frac{W l^3}{48 E I} c = .07 \times .056.$$

in which

d = maximum deflection of beam,
W = load,
E = modulus of elasticity,
I = moment of inertia of section,
l = length of beam,
n = distance from W to nearest support,
c = correction factor,
$f = \frac{n}{l}$.

These curves give an immediate impression of the value of deflection as the load moves from the middle. Curves A, B and C are derived, respectively, from formulas by Merriman, the "Carnegie Pocket Companion," and Reuleaux. It is quite curious to see how these prominent authors differ. Merriman (A) is the most correct.

Lysstationen, Odense, Denmark.



DEFLECTION CURVES FOR BEAMS WITH UNSYMMETRICAL LOADS.

Legal Notes.

BY E. P. BUFFET, LL. B.

WARRANTY ON AN EMERY WHEEL.

A case was not long ago decided by the Supreme Court of Minnesota, which lays down the principle that a dealer who sells an article with a manufacturer's warranty marked upon it does not necessarily adopt that warranty as his own. A blacksmith had bought from a dealer an emery wheel to be used for sharpening tools. The face of this wheel bore a printed card containing the manufacturer's name; the word "speed," opposite which were the figures "1,800"; besides the word "warranted," and others. About a month after the blacksmith bought this wheel, it broke and severely injured him. He sued the sellers for damages for breach of express warranty. His action was dismissed and from an order denying a new trial he appealed. In affirming this order the Supreme Court, per Brown, J., says:

"A warranty consists in representations and statements of and concerning the condition and quality of personal property, the subject of sale, made by the person making the sale to induce and bring it about. So far as the evidence in the case at bar shows, nothing whatever was said between the plaintiff and defendants concerning the condition or quality of the wheel, whether it was capable of making 1,800 revolutions per minute, or any other number of revolutions, or as to whether it was fit and suitable for any particular purpose. Attention was not called by either party to the al-

leged printed warranty, and, for aught that appears from the record, the same was not noticed by either at the time of the sale."

The court adds that the question of recovery from the sellers on the theory of implied warranty could not be considered, since the plaintiff in his complaint had relied upon an express one, and further raises a doubt, to say the least, whether they were liable on implied warranty, not being manufacturers of the wheel.

Since it does not appear that the manufacturers of the wheel were parties to this action or had opportunity to explain its breakage, it would be obviously unfair, as well as unnecessary, for us to mention their names. 92 N. W. Rep. 478.

The Crowding of the Machinery and Boilers of Our Warships.

The battleship from its inception has always been very powerful on paper. It will be found in practice that the results secured will not be as great as those anticipated. This difference between apparent and real strength has been due to the fact that the engineer has had too little to say in the design and construction of the ship, and has been too much interfered with in its operation. The engineer has vainly tried to point out the fact that, no matter how many guns a warship might carry and however well its sides might be protected, it was absolutely essential that the vitals, or the motive power, should be installed with the same care and facility for operation as the gun itself. If the lungs or heart of a giant be weakened it matters not that he had powerful arms to strike or a hardened body to receive heavy blows. The boilers are the lungs of a vessel, and the strokes of the engine are the heart throbs, and the limit of endurance ceases when these organs fail to operate.

All manner of limitations have been placed upon the engineer, thus hampering him in bringing forth a perfected design. Even up to the present time the only penalization for weight to which the contractor is subjected is that of machinery and boilers. On board a modern warship the weight of the luxuries will actually approximate 20 per cent. of that of machinery and boilers. It seems incomprehensible that a heavy financial penalty will be inflicted upon a shipbuilder who will provide for increased endurance and safety of the machinery by making some of the working parts heavier, while at the same time no financial penalty will be inflicted upon the same builder in case the weight of the luxuries should be greater than that originally allowed. In plain words, he is punished for making the ship more efficient and safe. Is it surprising, therefore, that the warship of one generation is the junk heap of the next, when practically everything is subordinated to making more attractive the appliances that are within sight, although such action causes a dangerously small factor of safety to be allowed for machinery and boilers? Massive and heavy furniture will be fitted in the ship, and yet essential portions of the machinery will be shaved to the danger point to save a few pounds in weight of some running part that is subjected to severe and continuous strain.

The sacrifice of machinery weights for the installation of luxuries that are not found in the ships of other navies has been carried to such an extent that one of the foreign Naval Attaches, stationed in Washington, said that no British admiralty afloat enjoys some of the luxuries that are possessed by the enlisted men doing duty on board the large American warships.

Prince Henry of Prussia is also reputed to have said respecting the installation of luxuries on board our large warships that such care for the comfort of the enlisted men was magnificent generosity, but he did not believe that fighting men were made in that way.

The continuous breakdown to which warships were subjected soon convinced thoughtful naval experts that some heed had to be paid to the demand of the engineer, and thus with each advance in the construction of the modern battleship more weight and space were proportionally allowed for the installation of motive power. As a result there was not only a gain in speed, but increased reliability and endurance was effected. The steaming radius was lengthened and the comfort of the crew augmented. The battleship of one decade is simply superior to that of its predecessor because its displacement is greater. The same size gun and practically the same design of turret has been used in all. The increase in both length and beam of the ship has caused a more efficient and enduring installation of machinery. The ventilation of the vessel has been improved thereby. The vessel has been made a better gun platform. It has been possible to improve the means of securing a rapid and reliable supply of ammunition. The arc of gun fire has been increased, and the comfort of the men improved.

While much has been done to promote efficiency above the protective deck, there still remains much to be done in improving things in the engine and fire rooms.—*Rear Admiral Geo. W. Melville, in Philadelphia Ledger.*

An Alloy for Fusible Patterns.

We have before this called attention to the use of fusible patterns for shapes that are not easily drawn and to the simplicity of the molding operation involved. The fusible pattern is simply rammed in solid in a flask without a parting, with of course the necessary channel for pouring. The mold is then heated in an oven or otherwise to a temperature above the melting point of the pattern, and upon inverting the mold the pattern runs out and the mold is ready for pouring. The casting obtained is of course free from fins or overlapping joints. An alloy for these patterns, which are usually made in a plaster of paris mold, has recently been patented. It consists of equal parts of lead, bismuth and zinc. We find precisely these proportions in an old edition of Haswell. The alloy is there said to melt at 200 degrees Fahr.

Power Required to Drive Machine Tools.

We are indebted to the General Electric Company for the following table of the sizes of electric motors which they have compiled "for the general run of work":

	H.-P.
Sensitive drills	¼
12" to 20" drills	1
20" to 24" drills	1½
36" and 40" drills	2½
30" and 40" heavy duty drills	3½

DRILL PRESSES.

	H.-P.
Speed lathes	1
22" and 24" lathes	2
26" and 30" lathes	2½
36" and 42" lathes	3½
48" and 54" lathes	5
60" lathes	6
72" lathes	7½
84" lathes	10

LATHES.

	H. P.
37" boring mill	4
51" boring mill	5
5' boring mill	6
6' boring mill	7½
7' to 9' boring mills	10
10' boring mill	12
12' to 16' boring mills	15
16' to 25' boring mills	18

BORING MILLS.

	H. P.
20" x 20" x 6' single-head planer	3½
30" x 30" x 8' single-head planer	5
42" x 42" x 10' single-head planer	7½
60" x 60" x 12' double-head planer	10
72" x 72" x 14' double-head planer	15
84" x 84" x 18' double-head planer	20
10' x 10' x 24' double-head planer	30
12' x 12' x 24' double-head planer	40

PLANERS.

	H. P.
12" stroke	5
18" stroke	7½
24" stroke	10
30" stroke	10

CRANK SLOTTERS.

	H. P.
16" stroke	3
24" stroke	5
30" stroke	5

SINGLE-HEAD SHAPERS.

	H. P.
24" between housings	7½
36" between housings	10
42" between housings	15
4' to 6' between housings	15 to 20

MILLING MACHINES.

These data are from actual tests of machines under general machine-shop duty. The General Electric Company point out, however, that no list of this kind can be followed blindly. The new high-speed steels especially complicate the problem. To illustrate this, the company refer to two 26-inch lathes, of which the first is used for roughing steel shafting at a speed of 100 feet per minute with a ⅜-inch cut and ⅛-inch feed, while the other is used for finishing, or light cast-iron work with perhaps a maximum cutting speed of 75 feet per minute, a ⅛-inch and 1-16 inch feed. The first machine will require a 35 horse-power and the second a 5 horse-power motor.

Shunt Field and Variable Voltage Control for Electric Motors.*

BY WILLIAM COOPER.

SELECTION OF MOTORS.

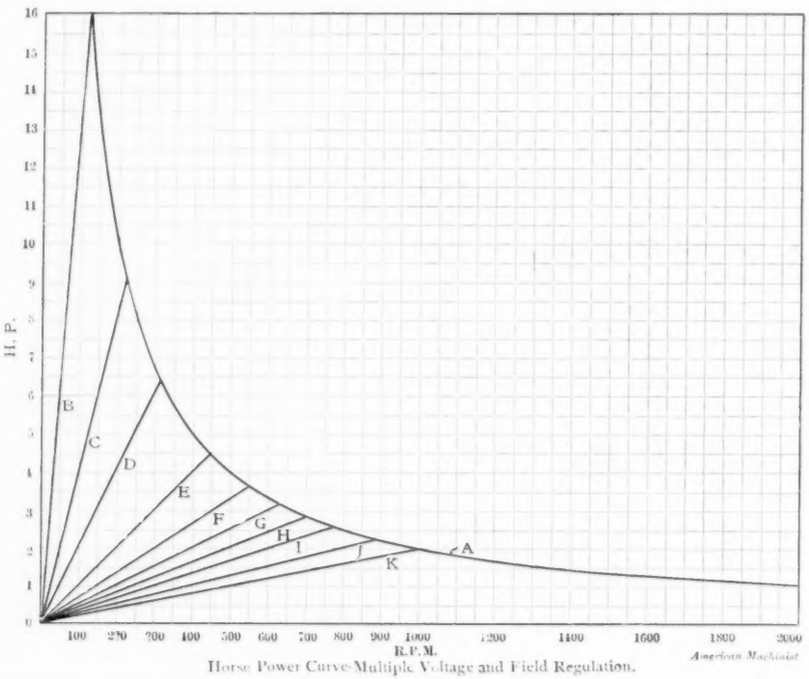
In equipping machine shop tools with electric drive, there are many points to be considered in the selection of suitable motors. The first consideration which directly affects the cost of installation is the highest permissible speed at which the motor can be operated.

After determining this point, the next point is its lowest speed, and then we have the range through which the motor is to operate, and after determining this range, the next question is the determination of the method of obtaining this range of speed, if it is desired to get different speeds by varying the speed of the motor. When using the so-called variable speed motor, there are two methods available which practice has shown to be good—one by varying the field strength, the voltage on the armature remaining constant; the other by varying the voltage on the armature, the field strength remaining constant. The method which first presents itself is, varying the field strength of the motor. This is a very simple and effective way, but it is accompanied by the disadvantage of requiring a larger motor than the other method. For instance, if a speed range of 2 to 1 is required, and the motor is run from a source of constant potential, the motor would require to be twice as large as a motor giving the same range by varying the voltage on its armature. In other words, a motor that will give 1 horse-power at 2,000 revolutions per minute maximum with a weakened field, and would also be capable of running at 1,000 revolutions per minute on a full field, would give 2 horse-power at 1,000 revolutions per minute. This motor would, of course, if designed to run at full field strength at 2,000 revolutions per minute, give 4 horse-power.

In the second method, that of varying the voltage on the armature, the field remaining constant, the size of motor required for a given range can be compared as follows: Assume, as above, a speed range of 2 to 1 is required and the speed will be varied by changing the voltage on the armature. One horse-power being required at all speeds as above, and 1,000 revolutions per minute being the minimum and 2,000 revolutions per minute being the maximum, a motor that would give 1 horse-power at 1,000 revolutions per minute on full field would give 2 horse-power at 2,000 revolutions per minute with the same field strength, but with double the voltage on the armature. Thus it is seen that in one method the motor has minimum horse-power at its maximum speed, while in the other the motor has minimum horse-power at minimum speed.

DETERMINATION OF MINIMUM SIZE MOTOR.

If it is desired to have a motor that will give a speed variation of 4 to 1 by shunt field resistance, instead of 2 to 1 as in the former case, the motor would be four times as large (instead of twice as large as in that case) as a variable voltage motor to do the same work. Thus, it is seen that the limitation of shunt field control is soon reached. However, a combination of shunt field control and multi-voltage circuits gives an arrangement by which a comparatively wide range of speeds can be obtained without the motors being of excessive size. This may be readily understood by referring to curve sheet attached, in which curve *A* represents change in horse-power of any motor when running on a weakened field. This might be called a diminution of horse-power curve. For instance, on the curve we see that a motor that will give 5 horse-power at 400 revolutions per minute gives 1 horse-power at 2,000. From this curve we can determine the minimum size motor that will be required for any given case, using either shunt field regulation entirely, or combining shunt field regulation and multi-voltage, or multi-voltage entirely.



Horse Power Curve-Multiple Voltage and Field Regulation.

It might be stated that the very large class of machines which operate on cylindrical work, barring a slight change in friction load through the different speeds of the machine, the cutting speed remaining constant, the horse-power remains constant.* Suppose for instance that a given machine tool requires 1 horse-power to operate it under all varying conditions of service, and it is required to have a speed range of 4 to 1, we can get this in three ways; one by using entire field regulation, which will require a motor 4 horse-power at 500 revolutions per minute with normal field strength, as shown by the diagram, or a motor can be used, if two voltages, one of which is double the other voltage, are available, this motor will be required to be 2 horse-power at 1,000 revolutions per minute, at normal field strength, or one-fourth as large as the motor giving this range by field control entirely or this motor can be run at 2,000 revolutions per minute by increasing the voltage. The horse-power of this motor, due to reduction in speed, by reduction in voltage will decrease along line *K*, Fig. 1, so that at 500 revolutions per minute it will give 1 horse-power and also give 1 horse-power at 2,000 revolutions per minute by weakening its field following line *A*, Fig. 1. It is seen from the curve that with two voltages, one of which is double the other, in combination with weakening the field, that the range of speed of 4 to 1 is the maximum that can be obtained from a motor which will be worked to its full capacity at both the minimum and maximum speeds.

If any greater range than this is required, under these conditions a larger motor must be used. For instance, suppose that a speed range of 5 to 1 is required, and the variation obtainable by changing voltages is only 2 to 1. Assume as before that the maximum speed is 2,000 revolutions per minute, the minimum speed will be 400 revolutions per minute. Now as 400 and 800 will be the speed variation by change in voltages, these voltages being in the ratio of 2 to 1 (say 110 and 220 volts), a motor will be required that will develop 2½ horse-power at 800 revolutions per minute on

* Extract from a paper read before the Cincinnati chapter of the American Institute of Electrical Engineers. The highly useful diagram is original with Mr Cooper, and deserves to be called Cooper's diagram—Ed.

* Other observers do not agree with this statement, especially as applied to large lathes. In any event, it should be remembered that with large tools the friction load is a much larger part of the total load than with small tools.—Ed.

full field, or in other words, where the curve *A* crosses the ordinate of 800 revolutions per minute, Fig. 1. The horse-power of this motor will decrease as all other motors, directly in proportion to its speed by reduction in voltage, will therefore be 1¼ horse-power at 400 revolutions per minute, following line *E*, Fig 1, being, in this case, slightly in excess of the power required at the slowest speed. The motor, however, in this case would be equivalent to a 3.1 horse-power at 1,000 revolutions per minute, as found by continuing line *E* to 1,000 revolutions per minute, or more than 50 per cent. larger than a motor to do the same work with a speed range of 4 to 1.

Mr. N. W. Storer, of the Westinghouse Electric & Manufacturing Company, in a paper read before the American Institute of Electrical Engineers, in New York, November 21 last, in defense of the system as outlined above, said:

"The operation of motors on this system is most satisfactory. The fact that the speed is increased so much by weakening the field might lead some to think that the commutation would suffer, but such need not be the case. An example will demonstrate the truth of this statement. A certain machine requires a 5-horse-power motor to operate it with a speed variation of 1 to 4, say from 375 to 1,500 revolutions per minute. On the three-wire system this motor will be a standard 10 horse-power 220-volt motor, operating normally at a speed of 750 revolutions per minute. Run with full field strength on the 110 volt circuit, which has only half its normal voltage, the motor will easily stand an increase of speed of 60 per cent. to 75 per cent., bringing the speed up to 600 or 650 revolutions per minute. When it is changed to the 220 volt circuit, it will have its normal capacity for 10 horse-power at 750 revolutions per minute; but only half load is required and it will commutate this as easily at a speed of 1,500 as it would 10 horse-power at 750, because both field strength and armature current will be divided by two. From this it may be seen that when the motor is running at full armature current, the voltage is only one-half the normal voltage. When the motor is operating at full voltage, the armature current is only one-half the normal current. If speed variations of 1 to 6 are required, they can be secured by a very slight increase in the normal field strength of the motor."

The last sentence of this quotation from Mr. Storer's paper would lead one to believe that there was but a slight difference between a motor that would give a speed range of 6 to 1 and a motor that would give a speed range of 4 to 1. As a matter of fact, the motor that would give a speed variation of 6 to 1 on the three-wire system, as outlined by Mr. Storer, would be 2¼ times as large as the motor to give 4 to 1 on the same three-wire system. This is very easily deduced from the curve shown. However, if a different ratio of voltages were available, to operate the motor upon, a motor that would give a 6 to 1 variation would be only 50 per cent. larger than a motor to give a range of 4 to 1.

Assume that a speed range of 10 to 1 is required, with, as before, 1 horse-power at all speeds, the motor which would fulfill the conditions of being worked to its full capacity at the minimum and the maximum speeds would be the motor whose horse-power would be represented by the line *G*, Fig. 1. This motor would have as maximum rating 3.2 horse-power at 640 revolutions per minute or a range of speeds by voltages of 3.2 to 1, so that the range of voltages must bear this ratio. A motor that will give this speed variation by shunt field regulation entirely would be 10 horse-power at 200 revolutions per minute. This motor would give 32 horse-power at 640 revolutions per minute, if designed to run with full field strength at this speed, or would be ten times as large as a motor giving the same range, operating on a combined system of multi-voltage circuits and shunt field regulation. Thus it would seem that shunt field regulation is prohibitive for any such speed range as 10 to 1.

In explanation of the curve, it might be said that the lettered lines representing the change of horse-power due to change in speed, are not strictly according to change in voltage, but change in revolutions per minute, but they vary so little from this that no great error will be introduced in using these lines to represent the range of voltages as well. The curve *A* representing the decrease in horse-power due to change in speed by shunt field regulation is strictly correct.

In further explanation of the use of the curve attached, in any given instance, if the speed range has been determined, as well as the maximum and minimum speeds, the full field voltage or normal rating of the motor can be ascertained from the curve as follows: Locate on the curve *A* the point corresponding to the maximum speed which it is desired to operate. Trace to the left from this point on the scale of ordinants and read the horse-power.

This horse-power may not be the actual horse-power in any given case, but it can be assumed as proportional to the actual horse-power required.

Again trace from the minimum speed, which is desired to operate, vertically until the horizontal line which represents the same horse-power that was determined from the curve *A* is reached. Through this point draw a straight line from the origin *O*, intersecting the curve *A*. From the point of intersection trace downward to the base line and the full voltage full field speed of the motor will be found.

Now to get the minimum speed we must use some other method than field control, because the field is already up to its maximum strength, and we therefore introduce a lower voltage. The ratio that this lower voltage bears to the normal voltage is the same as that which the lower speed bears to the normal speed. By this combination of multi-voltages and field control we are able to get the minimum size motor for the given work.

To illustrate, let us assume that it is desired to operate the motors at a minimum speed of 350 revolutions per minute, a maximum of 2,100 revolutions per minute, as has been suggested for some installations.

We have a rating of approximately 1 horse-power from the curve *A*. Tracing vertically from 350 revolutions per minute to the line which corresponds to 1 horse-power, and drawing a straight line from the origin *O*, through this point until it intersects with the curve *A*, we find that the full voltage full field speed of the motor should be 825 revolutions per minute, *I*, Fig 1.

The ratio between 350 and 825 is 2 3-10 approximately. This would, therefore, be the ratio of the voltages (maximum and minimum) to be used. If the maximum voltage is 250 volts, the minimum voltage would be 110. The motor would run at 350 at full field on 110, and run at 825 on full field at 250, and 2,100 on weakened field at 250 volts.

However, assume that it is desired to get this same speed range, the ratio of voltages being 2 to 1 instead of 2 3-10 to 1, as in the previous case. As the minimum speed will be given by the lowest voltage, the highest voltage will of course give twice that speed, or 700 revolutions per minute. From the curve *A* it is at once seen that the smallest motor that can be used to give 1 horse-power at 2,100 revolutions per minute will give 2 8-10 horse-power at 700 revolutions per minute. This is a point which is found by tracing vertically from base line at 700 revolutions per minute to the curve *A*. Following the line *H*, Fig. 1, toward the origin, until we come to the point that corresponds with 350 revolutions per minute, we see that this motor will give 1.4 horse-power at 350 revolutions per minute, or is in excess of the power required at this speed.

In comparing the size of the motors required to do given work, one at full voltage full field speed of 700 revolutions per minute, the other at full voltage full field speed of 825 revolutions per minute, one would give 3.3 horse-power at 825 revolutions per minute, as against 2.4 horse-power at 825 revolutions per minute of the motor having the wider range of voltage.

It has developed that the multi-voltage system, consisting of four wires and three different voltages, having a total range of voltages of about 4 to 1, while fulfilling the conditions for which it was designed,

is not being worked to its utmost capacity as regards speed range; the reason for this being mechanical limitations. That is to say, that where a range of 7½ to 1 is now obtained, one would be able as far as the motor is concerned electrically to get a range of 16 to 1. The reason for this is that the motor is not speeded up above its full field voltage speed to as great an extent as it might be, and still develop the same power that it develops at its minimum speed.

As seen by the curve referred to the available range of speed for constant horse-power on any given motor is as the square of the ratio of the voltages on which it is operated. That is to say, if a speed range of 9 to 1 is desired, the voltages need have a ratio of only 3 to 1. From this it is at once observed that it is unnecessary to use a range of voltages of 4 to 1 for a speed range of 7½ to 1.

In referring to constant horse-power it is not to be understood that this horse-power is the maximum horse-power of the motor. It is the maximum horse-power, however, that the motor will yield at its minimum and maximum speeds. At all intermediate speeds it will have an excess power.

All of the limitations in regard to speed range for any given range of voltages are based on using a motor of the smallest possible size to develop at its minimum and maximum speeds the power called for. This applies only to motors delivering practically a constant horse-power at all speeds.

MOTORS FOR SLOTTERS, PLANERS, ETC.

Great care should be exercised in selecting motors for different machines to determine whether the horse-power required is practically constant or varies with the speed. In most machines of a reciprocating nature, slotters, shapers, planers, etc., the power required varies with the speed, as the power is consumed in the machine in reversal and not in the actual work being done. In cases of this kind the motors should be specified to run on full field, full voltage at the maximum speed required, getting speed variation by the use of the multi-voltage circuits and shunt field resistance for intermediate speeds. That is, no resistance is to be used in the shunt field of the motor when the motor is operating on full voltage.

Some trouble has been encountered in getting speed variation on the class of machinery in which the horse-power varies with the speed by using shunt field resistance. This will be entirely overcome by the arrangement proposed.

In some installations, the speed range as well as the number of different speeds is very much less than has been gotten with the four-wire system of multi-voltage. Where a range of 7½ to 1 with twenty-six different speeds has been obtained by the four-wire multi-voltage system, the range has been 5 to 1 with six and eight speeds on other systems. It is evident that such a reduction in speed range and in the number of speeds must naturally reduce the cost of an equipment, at the same time very materially reducing its efficiency.

In the case of a speed range of 4 to 1, considering a maximum speed of 1,450 or 1,500 revolutions per minute, as in the previous case, the minimum speed instead of being 200 would be 360 to 375 revolutions per minute, and as the minimum speed determines the size of the motor for a given horse-power, the motor should be just that much smaller.

Mr. Blackwell, in his paper, said: "It is therefore seen that a motor to be used on the multi-voltage system will have to be sufficiently large to carry its maximum horse-power at the minimum potential; or, in other words, at say 40 volts on a 250-volt system, the motor will have to be six times too large when working at its maximum potential."

This is, of course, strictly true, and applies equally as well to speed regulation obtained by shunt field resistance, only in a very much magnified degree. While a motor will be six times too large when operating at six times its speed, the speed being increased by an increase in voltage in order to get the same range by shunt field regulation, the motor would require to be thirty-six times the size it would be if only operating at the one maximum speed. This in itself is sufficient proof of superiority of the system of getting variable speeds by variable voltages over the system of shunt field regulation exclusively.

From this it follows that a motor whose speed is to be varied by change in voltage, field excitation remaining constant, will be directly proportional in size to the change in speed, while a motor whose speed is to be varied by change of field excitation, will be in size as the square of the change in speed.

RULES FOR DETERMINING SIZE OF MOTORS.

In conclusion, the writer would indicate a few rules to be used in determining relative sizes of motors for constant horse-power application.

First—The total range of speed, using both variable voltage and field regulation, will be as the square of the range of voltages.

Second—Change of horse-power will be directly proportional to change of voltage on armature, field being constant.

Third—Change of horse-power by change of field strength will be inversely proportional to change in speed, voltage on armature remaining constant.

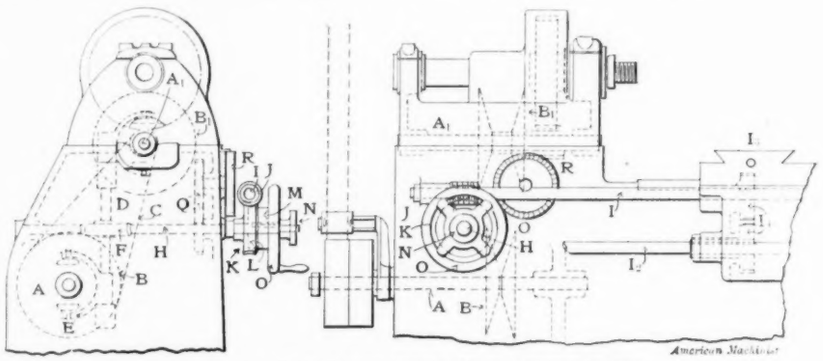
Fourth—The relative size of motor as referred to the maximum speed will be directly proportional to its speed variation when using variable voltages.

Fifth—The relative size of motor as referred to the maximum speed will be as the square of the speed variation when using field regulation.

Variable Speed Mechanism for Engine Lathe.

The accompanying illustration taken from the *Mechanical Engineer*, of Manchester, England, represents a new variable speed arrangement for engine lathes, this being the design of R. Lang, of John Lang & Sons, Johnstone, near Glasgow, Scotland.

The driving shaft in this arrangement is at *A*, this carrying at its outer end the pulley belted, as indicated, from the counter. On shafts *A* and *A*1 (the latter being geared to the lathe spindle) are mounted in pairs conical disks *B* and *B*1, which are provided with a bevel edged driving belt *C*. These disks are provided with feathers and arranged to slide on their shafts and thus form pulleys of variable diameter. By means of the vertical shaft *D*, either pair of cones is opened or closed as desired, the other pair being moved in an opposite direction and thus keeping the belt tight at all times. Shaft *D* is fitted at each end with a fork *E* engaging with the hub of one of the conical disks, and has at *F* a worm wheel meshing with a worm on shaft *H* by which it is turned to operate the disks. Shaft *H* may be driven, and the speed of the spindle varied, automatically through shaft *I*, geared from feed rod *I*2, *I* having a worm *J* meshing with worm wheel *K* on *H*; this worm wheel is mounted loosely on its shaft, but is readily connected to it by means of a friction clutch *L* on sleeve *M*, which is keyed to the shaft, the clutch being operated by turning a nut *N* at the front. For varying the speed by hand the



VARIABLE SPEED MECHANISM FOR ENGINE LATHES.

wheel *O* is provided, this being keyed to shaft *H*.

The automatic feature should be especially useful in cutting-off or facing work, as the spindle speed may be increased as the tool feeds toward the center to give the work at the point of contact with the tool—although of constantly diminishing diameter—an approximately uniform surface speed.

The spindle speeds obtained as shaft *H* is rotated are indicated by a graduated dial *R*, which is mounted on a shaft *Q* driven through spur gears from shaft *H*.

Numbering and Storing Patterns.

BY S. A. WORCESTER.

Many shops need a good system of numbering and storing patterns. Sometimes patterns that should be all kept in one room are scattered around in three or four different rooms or buildings. Shelves or racks are put up without any regular order being observed. Shelves or sections in which patterns are stored are seldom marked clearly in large figures, as they should be. Still more seldom is a particular place marked for each pattern. Often the shelves are built too high so that ladders are a constant necessity. I recently visited a newly finished pattern storage building in which the shelving reached a hight of twenty feet. This will make a clumsy ladder necessary when the upper shelves are used, and there will be more time wasted hunting and handling the ladders than it should take to handle the pattern, not to mention the occasional dropping and breaking of patterns and sometimes a man with a pattern.

I recommend the arrangement of floors and shelves, shown in Fig. 1, for wooden patterns of ordinary sizes for general foundry business. Sections which stand next to the wall should be half the width of this one which may be numbered on both sides for convenience. Passage-ways about four feet wide should be left between sections. Considerable matched flooring may be saved by omitting the floors under the shelves and flooring only the passage-ways. For the few patterns which are too large for these passage-ways and sections one or more platforms 12 inches high should be built near a large door. If any patterns are too large for a platform 5x16 feet, a platform 14x16 feet may be built, taking the space of two ordinary sections and closing one passage-way. These platforms should be numbered with large figures in the same manner as the sections. While the platforms may need to be much larger and heavier for the work of some builders of heavy machinery and the shelves may be closer together for the concerns using only very small patterns, the sizes I have given are practical for ordinary general machine business. The index card, as shown in Fig. 2, is self-explanatory. The numbers shown on the uprights supporting shelves indicate divisions, each of which is called a shelf, and is so referred to in the card index. The asterisks penned after the numbers 7003, 7014 and 7016 indicate that these patterns include some loose parts or special features, which are enumerated and described on the back of the card, or if that has not room enough then the remarks are continued on one or more plains cards of the same size. These note cards are kept next in order in the index. One guide card for every 500 numbers is a convenient arrangement. If a very cheap index is desired the printing, numbering and title may be dispensed with and ordinary ruled cards used and all numbers penned on them. The cards may be merely ordinary square cards set in a plain cheap box without any device for holding them in and using no guide cards.

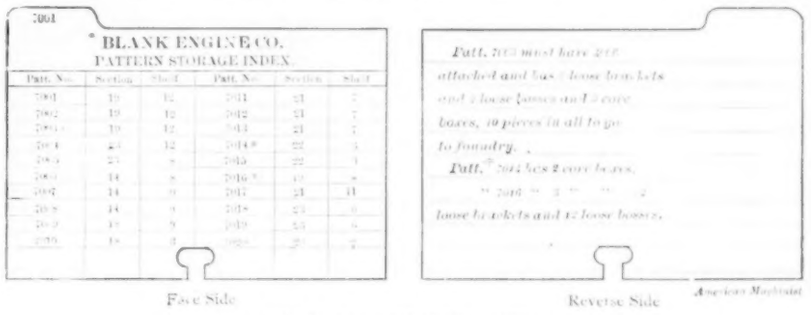


FIG. 2. PATTERN INDEX CARDS.

The pattern numbers for the shelves are printed consecutively with the typewriter on sheets of paper with the rear side gummed and are cut from the sheets as fast as patterns are located on the shelves and stuck on the edge of the shelf as near as possible to the place where the pattern is to be kept. It is well to keep the larger patterns on the lowest shelves and smaller ones on the middle and upper shelves, as far as possible. The shelf numbers may be printed on sheets of cardboard or perhaps taken from calendars with large figures and tacked on the uprights or they

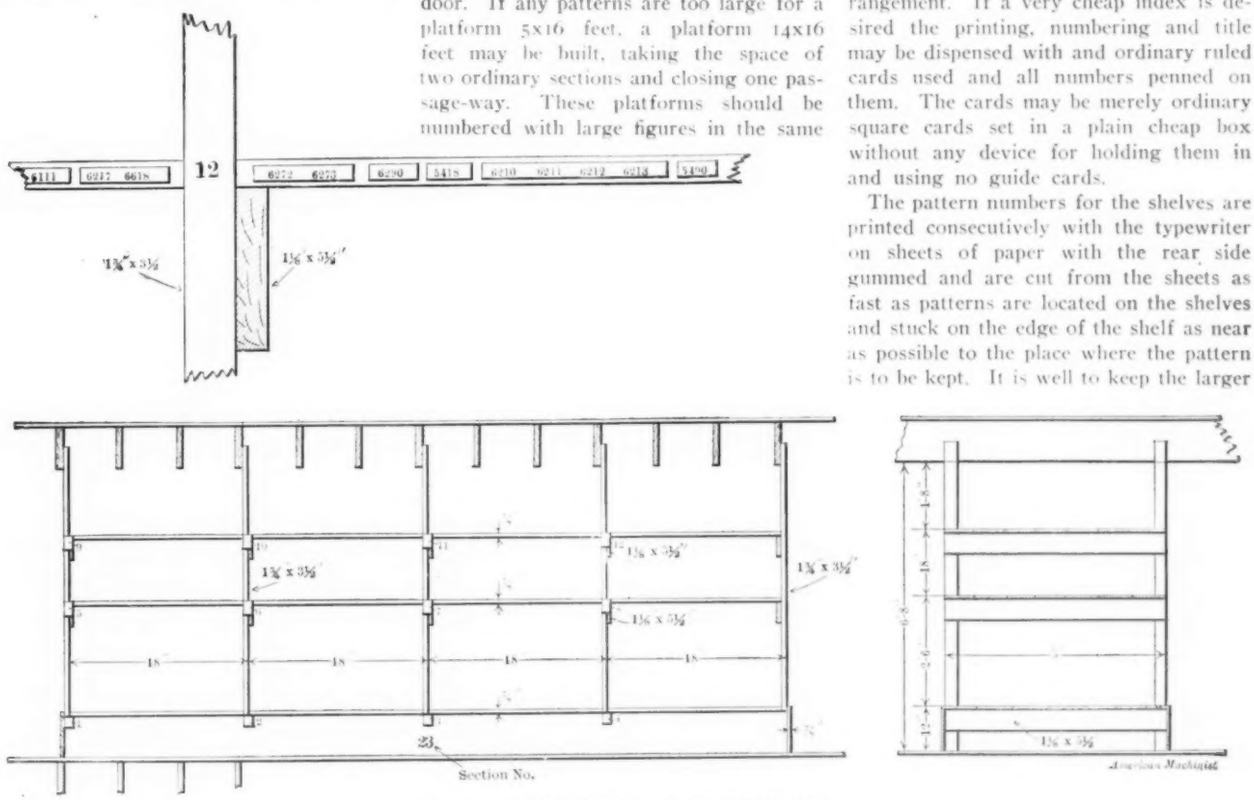


FIG. 1. ARRANGEMENT OF PATTERN SHELVES.

may be done on the wood with a marking brush. The section numbers should be at least 5 or 6 inches high to be seen well from a distance.

I recommend consecutive numbers for marking patterns and do not think the use of letters advisable. A firm for which I was at one time master mechanic used to make a practice of numbering each pattern with the number of the drawing on which the casting was shown, and if the drawing showed more castings than one a different letter was added to the number for each different pattern, thus, 3065B, 3065C, etc. Experience showed that customers ordering castings by the pattern number were apt to forget the letter and thereby cause a misfit. Many of the letters sound so much alike that mistakes were frequent in verbal orders. The most important claim made for this scheme was that the pattern number was also the drawing number, and it sometimes saved the draftsman the trouble of looking up a drawing number in the index. This feature proved to be of small value considering the large number of mistakes which resulted from using letters and numbers in combination and repeating the same numbers with different letters. Experience has convinced me that simple consecutive numbers are the most practical for patterns in general. I make no effort to have the pattern numbers placed consecutively on the shelves, because it is often inconvenient to do so. It is usual to give the numbers to the patterns in the drafting room, and it is hardly practical to have the draftsman make a trip to the pattern house every time he numbers patterns in order to number them in such a manner as to have the numbers consecutive on the shelves. The larger patterns must occupy lower shelves or platforms, while the smaller ones are placed on upper shelves so that if their numbers are made consecutive on the shelves they can hardly be made consecutive on the drawing. I therefore number patterns consecutively in the drafting room and fill up the pattern house shelves as fast as the patterns are made, regardless of the order of their numbers and index them as fast as they are placed on the shelves, so that it is always easy to find a pattern by the index.

Economical Machine Work in a Municipal Plant.

The report of the superintendent of the water works at Atlanta, Ga., makes a good showing for the machine shop maintained in connection with the works. There were a number of filters to be repaired, the manufacturers of which demanded $1,450 for the new parts needed. It was determined to do the work in the shop, getting outside parties to make to order what could not be made there. The materials cost $512.37 the labor $277.85, making the total cost $790.22, or only a trifle over one-half of what would have been charged for the parts alone.

The Air Buffer.

BY ERNEST R. BRIGGS.

Most engineers are familiar with the air buffer as a useful piece of mechanism for bringing rapidly moving parts to rest without shock, and it seems therefore a matter of some surprise that its use is not more general. Probably the best known application is to be found in the Willans engine, where it enables a single-acting engine to run with cast iron trunks for piston rods; connecting rods without bottom brasses on the big ends, and crank shafts to run with no upper brasses, thus giving the most perfect lubrication, combined with absence of knocking at the highest speeds, the wear of the brasses being automatically taken up by the constant thrust. How much the air buffer has done for the Willans engine may be gathered from the following quotation taken from "The Engineer" of April 5, 1895: "We are told that the story of the firm's origin is briefly as follows: Messrs. Willans and Robinson casually met on the river (Thames) and struck up a friendship. This led to discussions on the engine (the Willans valveless launch engine), and to its later manufacture. It was supplied to river launches only, there being no other market then. Electric lighting companies did not exist, and dynamos were few and far between. It was the dark age of distrust of electric light and its promoters. Many launches were built and fitted with these engines, of which several hundreds were made, but in spite of their many advantages their manufacture was gradually abandoned as the new central valve engine was developed. An exemplification of how advantageous the partnership formed became lies in the fact that the existing engine, the chief characteristics of which are the constant thrust and the air cushion, each of which would 'be nowhere' without the other, owes the first of these to Mr. Willans and the second to Mr. Robinson. Each of these gentlemen appears to have been as necessary to the other as whisky is to water in the concoction of a certain beverage, if our readers will pardon the simile."

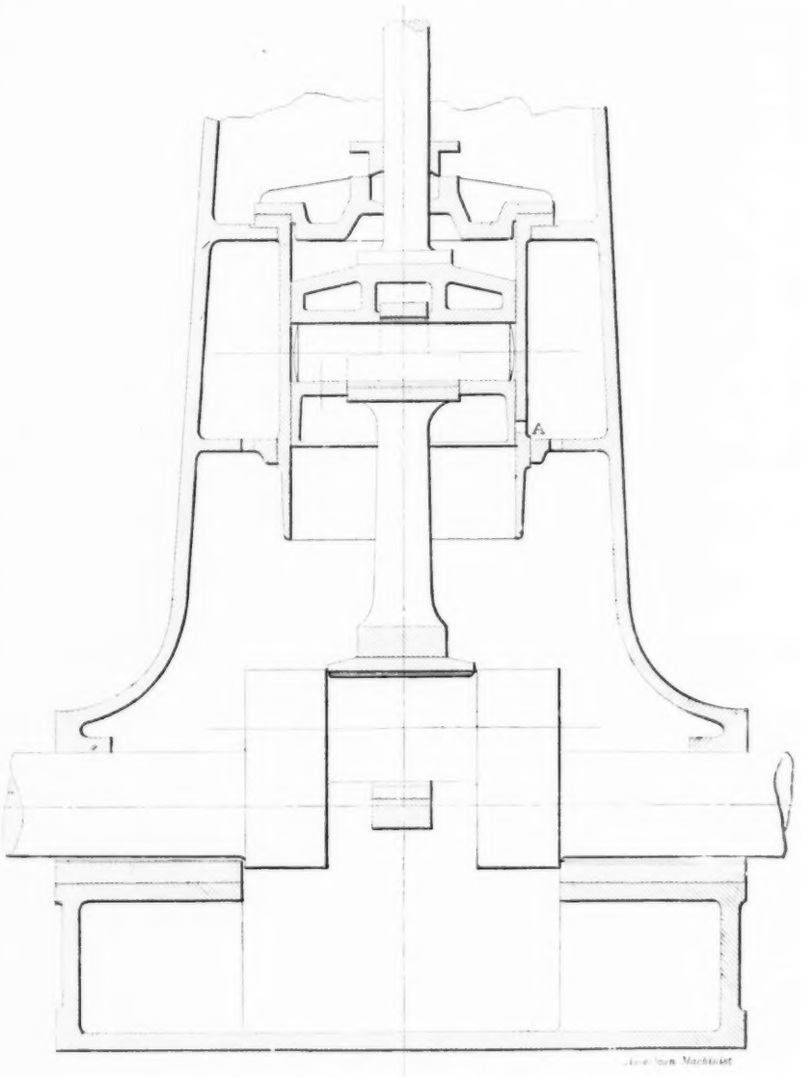


FIG. 1. AIR BUFFER OF THE WILLANS ENGINE.

Whether the air buffer is the whisky or the water I leave to "The Engineer" to decide. Fig. 1 shows the arrangement of the air buffer in an ordinary single-acting engine. It will be noticed that the crosshead is replaced by a large piston—known as the guide piston—which takes the side thrust due to the obliquity of the connecting rod. The guide piston works in a cylinder—the guide piston liner—which has a closed cover, the piston rod working through a gland. In the Willans engine the piston rod is, as mentioned above, replaced by a hollow cast iron trunk in which the ports are cut, the steam distribution being effected by means of piston valves actuated by an eccentric placed midway on the crank pin, the connecting rods being in duplicate. At the bottom of the stroke the guide piston uncovers a number of holes drilled thro the liner, as shown at *A*, Fig. 1, admitting atmospheric air to the interior. On the up stroke the air is compressed, thus forming a resistance which overcomes the upward inertia of the reciprocating parts, no small amount in a 3,000 horse-power engine running at 200 revolutions. It is important to note that there is no loss whatever, as the whole of the energy spent in compressing the air is returned on the down stroke. An indicator diagram taken from an air buffer shows only one line, the pencil returning on the line made by the preceding stroke. It is obvious of course that the equation for finding the curve of compression and expansion is the same as an air compressor, being $p\,v^n =$ constant. The value of the index varies very slightly for any given design of engine, and in cases where the exhaust chamber is immediately above the air buffer cover it may be taken as $p\,v^{1.25}$ without appreciable error. It is not advisable to have a terminal pressure greater than about 7 atmospheres, because of the difficulty in preventing air leaks, which means not only loss of work, but, in engines like the Willans, loss of vacuum, owing to the exhaust chamber being directly above the buffer cover. In engines like those built by Alley & Maclellan, of Glasgow, the air buffer is separate from the exhaust chamber by a distance piece, so that any leak of air passes to the atmosphere and does not destroy or lower the vacuum. In any case leak must be prevented as it, of course, means loss of work in the engine, as a whole. There is another reason why a high terminal pressure is inadvisable, which will be referred to later on, when we come to consider the method of calculating the guide piston diameter.

In the case of vertical gas engines designed with air buffers, the writer found that owing to the large amount of water cooling which took place the curve was much more nearly isothermal, the index not exceeding 1.10.

Before showing how to calculate the size of the guide piston for a single-acting engine, such as that shown in Fig. 1, it will be of interest to describe another and different application of the air buffer, but one which, unlike the preceding one, is not so successful, but yet not by any means devoid of interest. Fig. 2 shows in diagram what is known as the gunpowder pile-driver. The ordinary framing of the pile-driver has mounted at the top a cylinder *A* closed at the upper end. Fixed on the head of the pile is another cylinder *B* closed at the bottom. The tup or monkey *C* has two rams, one on the top to fit the upper cylinder *A*, and one on the bottom to fit the pile cylinder *B*. The action

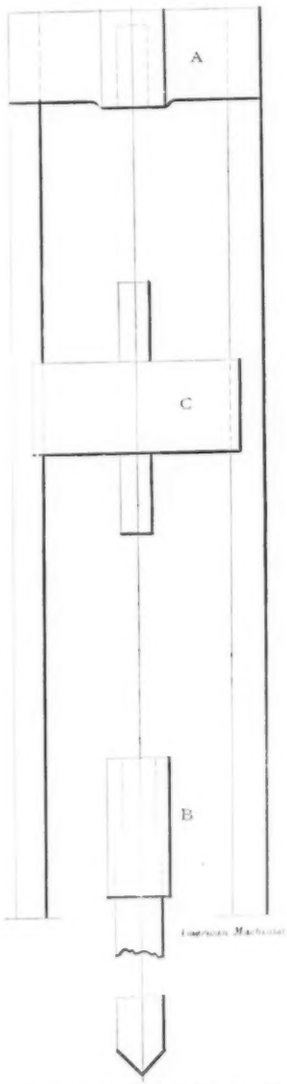


FIG. 2. THE GUNPOWDER PILE DRIVER.

is as follows: A charge of gunpowder is automatically fed into the lower cylinder *B* and the tup released, the descending ram enters the cylinder and compresses the air, the heat caused by the compression fixing the charge. Note that it is the heat of the air that fires the charge, and not the ram striking the powder. The tup then becomes a shot and returns to the top of the framing, where the upper cylinder *A* brings it to rest and accelerates its descent for the next charge; while the recoil of the firing drives the pile. It should also be noticed that the speed of the tup on reaching the pile again is the same as if it had fallen from the hight it would have ascended to if there had been no air buffer to arrest its progress. A very superficial consideration of the gunpowder pile-driver suggests a number of practical objections, but as my own experience does not run to these, it would be interesting to know if any of your readers have come across them.

It seems somewhat strange that the air buffer has not found an application in large stamps, particularly those of the board drop type. It is true many steam stamps and hammers have small coil springs, which of course are analogous, but they are used more for protecting the cylinder cover than as an energy equaliser or reservoir.

There are various ways of procedure for making the necessary calculations for determining the area of the guide piston. The following method will probably be found as convenient as any; and for the sake of convenience we will take as an example a single-acting vertical compound engine with an air buffer arrangement, such as that shown in Fig. 1, and to the following particulars: Stroke, 200 mm.; Revolutions (maximum at no load), 400 per min.; weight of two pistons and rod, 135 kgs.; weight of connecting rod, 48 kgs.; length of connecting rod (crs.), 500 mm.; assume weight of guide piston, 100 kgs.

The weights of the pistons, piston and connecting rods can be calculated from the drawings; for the present it is necessary to assume some weight for the guide piston. We have, then, to provide an air buffer sufficient to balance the inertia due to the mass of the above parts when the engine is running at its maximum speed. Since the connecting rod has a rotary motion, as well as a reciprocating one, it is necessary to make some correction for this. In practice, the writer takes two-thirds the total weight of the rod, and treats it purely as a reciprocating mass. Some authorities—notably Prof. Kennedy in his "Mechanics of Machinery"—state that no appreciable error is introduced by taking only half the weight of the rod.

If the connecting rod was infinitely long the formula for obtaining the total amount of inertia at either end of the piston stroke would be:

$$\text{Inertia} = .00112\ W\ R\ N^2 \text{ kgs.}$$

Where

W = total weight of reciprocating mass in kgs.

R = radius of crank in meters.

N = revolutions per minute.

Substituting values for this:

$$\text{Inertia} = .00112 \times 267 \times .1 \times 400^2 \quad (1)$$
$$= 4.785 \text{ kgs.}$$

where 267 equals weight of reciprocating parts, allowing 32 kgs.—or two-thirds—for the connecting rod. Thus we see that a force of 4.785 kgs. has to be exerted to start the moving parts on their

upward stroke, and the inertia being in direct proportion to the crank radius, it follows that at half stroke the inertia is *nil*. During the upper half of the stroke the inertia is acting upwards and requires a downward force to balance it, which amounts to 4,785 kgs. at the top of the stroke. If steps were not taken to control

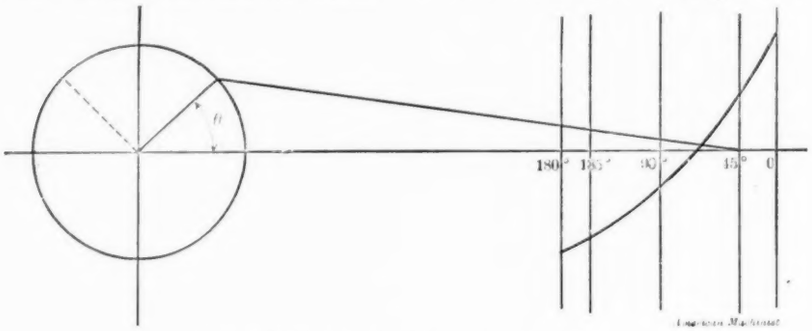


FIG. 3. CRANK ANGLES AND INERTIA CURVE.

this in some way, either by means of the air buffer or forced lubrication, the violent knocking would cause rapid wear on the brasses and prevent continuous high speeds.

Owing to the obliquity of the connecting rod the accelerations at the two ends of the stroke are not exactly the same, and it becomes necessary to make some correction for this, which is done by multiplying the inertia as obtained above with an infinitely long connecting rod, by the expression:

$$\cos.\,\theta + \frac{1}{n}\cos.\,2\,\theta \qquad (2)$$

Where θ = angle of crank from inner dead center (see Fig. 3), and n = length of connecting rod divided by crank radius. To facilitate calculations, Table I has been worked out for different values of θ and n.

Since the connecting rod is 500 mm. long and crank radius 100 mm. $n = 5$. It is generally sufficient to calculate five points, as in Table II and draw a curve through them.

The engine being vertical it is necessary to take the weight of parts into account as well as friction. The total weight of parts equals 283 kgs., the whole weight of connecting rod being taken in this case. Allowing the same amount for friction, we obtain a total resistance to upward motion of 566 kgs. These results are tabulated in Table II.

It is best to plot these full size if possible. This is done in Fig. 4, and the method is as follows: Draw the base line $A\,B$ and erect perpendiculars at A and C to represent extreme ends of stroke; A when the piston is at the bottom or outer dead center and C when the piston is at the top or inner dead center. $A\,C$ in this case equals 200 mm. At B erect the clearance line such that $C\,B$ is the amount of clearance in terms of the stroke. Taking the curve $pv^{1.25}$, if the clearance $C\,B$ is made .3 times the length of stroke the terminal pressure is sufficiently low not to cause trouble with the gland through which the rod passes. $C\,B = 200 \times .3 = 60$ mm. P_2, the terminal pressure, is found by the usual formula:

$$\log. P_2 = \log. P_1 + n\,(\log. V_1 - \log. V_2)$$

and equals 6.25 kgs. cm.^{2} absolute pressure. Below $A\,B$, which being the base line is also the atmospheric line, draw the zero line $H\,K$ parallel and 1 kg. c m.^{2} from it on the vertical scale of pressures. (Note—1 kg. cm.^{2} is called a metrical atmosphere and is equal to 735.51 mm. of mercury, being sufficiently near for all practical purposes. The absolute atmosphere equals 760 mm. of mercury.) Make $K\,L$ = 6.25 kgs. cm.^{2} to the pressure scale. With the axes $H\,K$ and $K\,L$ draw the air curve $A\,G$. This may be done either by calculation or more conveniently by the graphic method shown, which has been fully explained in the AMERICAN MACHINIST.* Erect perpendiculars F, E and D at the 45°, 90° and 135° positions of the crank respectively. All that remains to be done now is to plot the inertia curve on the diagram to such a scale that it will fall just below the air curve, the scale being the net area of the guide piston. Scale the air buffer pressure at the 45° position—*i. e.*, distance $D\,M$. This is about 2.5 kgs. cm.^{2} above atmosphere, and allowing a clearance between the two lines of, say, .25 kgs. cm.^{2}, we have 2.25 kgs. cm.^{2} for inertia, which at this position equals 2.817 kgs. above the base line. The required scale is, therefore, $\frac{2817}{2.25} = 1.252$ cm.^{2}. If the piston rod is 70 mm. in diameter, the total area would be 1,252 + 38 = 1,290 cm.^{2}. The nearest round size to this is 400 mm. diameter, and the net area would then be 1,256 — 38 = 1,218 cm.^{2}. Dividing the last column of Table II by this figure we get:

For θ =	0°	inertia =	4.25	kgs. cm.^{2}.
	45°	" =	2.31	"
	90°	" = —	1.25	"
	135°	" = —	3.24	"
	180°	" = —	3.61	"

Plot these on the diagram and draw the inertia curve $O\,P$. It is always best to plot the complete diagram, as it gives all points of the stroke and keeps a graphic record of the calculation.

There are of course various graphic methods of drawing the inertia curve, but

θ	$\cos.\theta + \frac{1}{n}\cos.2\theta$	Values of n.						
		3.0	3.5	4.0	4.5	5.0	5.5	6.0
0°	$1+\frac{1}{n}$	1.333	1.286	1.250	1.222	1.200	1.182	1.167
30°	$.866+\frac{.5}{n}$	1.033	1.009	.991	.977	.966	.957	.949
45°	.707	.707	.707	.707	.707	.707	.707	.707
60°	$.5-\frac{.5}{n}$	.333	.357	.375	.389	.400	.409	.417
90°	$-\frac{1}{n}$	—.333	—.286	—.250	—.222	—.200	—.182	—.167
120°	$-\left(.5+\frac{.5}{n}\right)$	—.667	—.643	—.625	—.611	—.700	—.591	—.583
135°	.707	—.707	—.707	—.707	—.707	—.707	—.707	—.707
150°	$-\left(.866-\frac{.5}{n}\right)$	—.700	—.723	—.741	—.755	—.766	—.775	—.783
180°	$-\left(1-\frac{1}{n}\right)$	—.667	—.714	—.750	—.778	—.800	—.818	—.833

TABLE I. INERTIA CORRECTION FACTORS.

θ	Equation I.	Multiplier from Table I.	Corrected Inertia	Weight and Friction.	Unbalanced Force in Kgs.
0°	4785	× 1.2	= 5742	—566	= 5176
45°	4785	× 0.707	= 3383	—566	= 2817
90°	4785	×—0.2	=— 957	—566	=—1523
135°	4785	×—0.707	=—3383	—566	=—3949
180°	4785	×—0.8	=—3828	—566	=—4394

TABLE II. RESULTS FOR AN ACTUAL CASE.

* Page 591, Vol. 23.

unless the graphic method saves a tedious calculation it is not always found advisable to use it, and as the method of calculation is greatly simplified by the use of Table 1, the writer prefers to use the method outlined here.

Having obtained the diameter of the guide piston, the weight can then be calculated and compared with the assumed weight. If the error is slight the necessary correction may be made by altering the clearance volume.

If the clearance volume is small the terminal pressure is high, but the pressure in the body of the curve, so to speak, between the 90° and 45° positions of the crank, does not increase nearly so fast as the terminal pressure; hence the pressure at the end of the stroke is unnecessarily high for the inertia, while earlier on in the stroke it may hardly balance the upward force, thus causing the engine to knock. Thus it becomes necessary to keep the terminal pressure down. On the other hand if the air curve was so low that it did not approach the inertia curve until near the end of the stroke the size of the guide piston would be larger than it need conveniently be made.

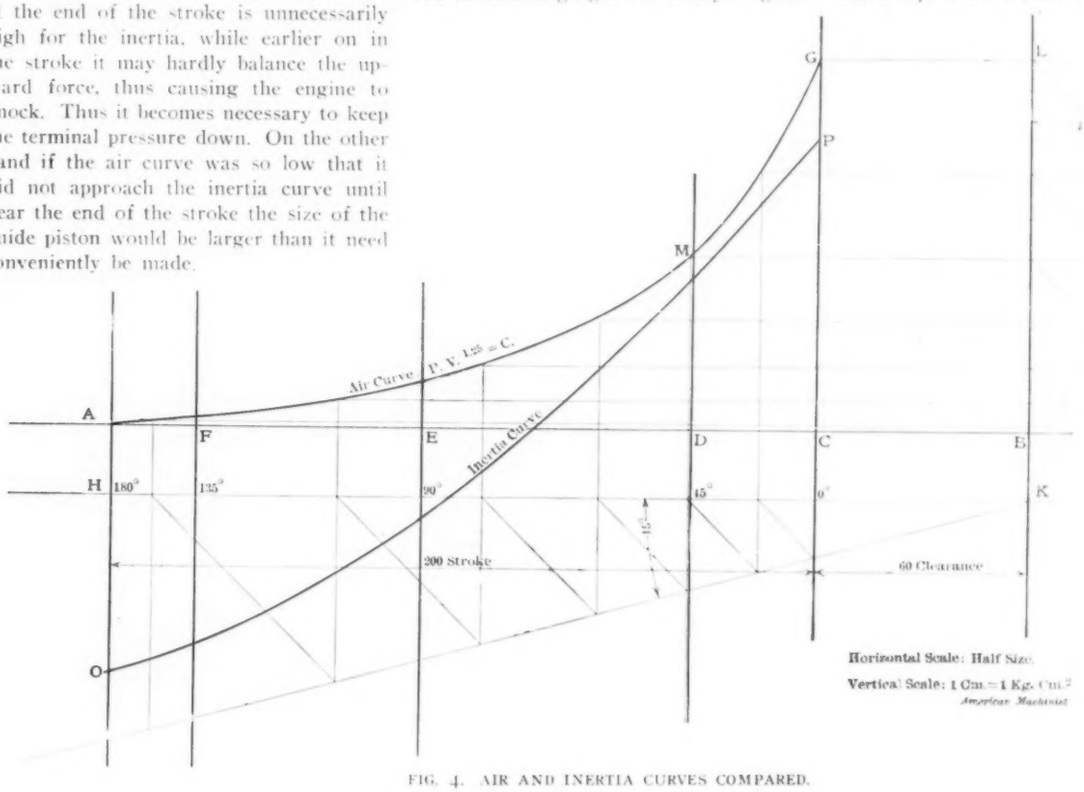


FIG. 4. AIR AND INERTIA CURVES COMPARED.

If the ordinary weights and measures are used, formula (1) becomes:

$$\text{Inertia} = .00034\, W\, R\, N^2$$

Where

W = weight of reciprocating mass in lbs.

R = crank radius in feet.

N = revolutions per minute.

Formula (2) and Table 1 remain the same.

Rugby, England.

For Bigger Warships.

When will the limit of size be reached, if each increase in displacement has made the ship a better fighting machine? The limit of size will not be reached until the demand of the engineer for space and weight for machinery is given the same recognition that is accorded the ordnance and hull experts. It is certain that warships must be made even larger, and in accordance with this belief the British Admiralty has projected battleships of 18,000 tons displacement. Boilers are still made too frail, since their tubes are too thin, their casings too light and their drums too small. This shaving in weight of important parts also extends to the engine-rooms, for engine frames are not as strong as they should be. The tubes of condensers are too contracted; the piping is too complex by reason of the crowding of auxiliaries, and altogether there is a forcing of appliance into contracted spaces beneath the protective deck that results in excessive repair bills and long stays in port. An increase in weight would keep the ships longer at sea, and it would seem that this reason alone would correct the evil of installing light machinery. Against the vigorous and determined protest of the engineer, the ships seem to be built for the hour of the contractors' trial, rather than for the day of battle.

From the standpoint of the quarterdeck, the modern battleship may seem to possess endurance and strength, but from the view of those beneath the protective deck this strength is more apparent than real.

It will be found in the next naval war that in the distribution of weights allowed in the construction of a modern war vessel, there has been too great a tendency to sacrifice the efficiency of the machines that are not within sight of the inspection officer, in order that the appliances above the protective deck may be made more efficient and that even luxuries may be secured.

It requires a resourceful and intelligent man to stand behind the modern gun, but it requires equal intelligence and skill to stand in front of the modern boiler or operate a high-speed marine engine. It will neither promote naval efficiency nor inspire confidence for either the man behind the gun or the man at the throttle to know that the weak line in the naval chain is contained within the engine-room, where the smallest factor of safety has been assigned to the working parts, and where the appliances must be subjected to the severest and most continuous strain.

It is by reason of the condition of affairs existing beneath the protective deck that the modern battleship will do only a small measure of work that will be expected of her when the ship is assigned for distant operations. The larger the size of the battleship, however, the more satisfactory will be her performance, for every increase in displacement means a proportionate and relative increase in engineering efficiency. —*Rear Admiral Geo. W. Melville, in Philadelphia Ledger.*

The Real Heroes of the Sea.

A Washington correspondent sends us a clipping from a recent issue of the *Evening Star*, of that city, which contains some interesting examples of engineering as it is done in the offices of the daily papers. These hair-raising stories are given on the authority of "the manager of a transatlantic line," and are duly embellished with pictures taken no doubt, on the spot. The first story tells us of red-hot boilers and of expeditious cutting out old and "reaming in" new tubes under conditions that would seem to be rather trying:

"A certain steamship in the Pacific trade had been sent out from her home port

with the majority of her boilers out of commission. In midocean one of the few boilers capable of being fired got leaky tubes, and it became necessary, in order to keep the ship under any sort of headway in a hurricane-swept sea, to repair the boiler immediately. The fire was pulled out from under it, the manhole lid was unscrewed and removed, and the first engineer, wrapped from head to foot in a thick coating of asbestos, crawled into the red-hot boiler and with chisel and hammer began tearing out the defective tubes. For two minutes he worked, and as he worked, held his breath, for a single gasp of the fiery air in his lungs would have killed him. Then he crawled to the manhole and was pulled out by stokers.

"Five minutes later he again went into the boiler. This time, after nearly two minutes' work, he succeeded in cutting away two tubes. On the third entry he removed three, and after that he spent another five minutes resting.

"Then came the task of reaming in new tubes, and to do this he was compelled to enter the boiler five times. In each case he stayed inside nearly two minutes, and as he crawled out the last time he barely had breath and strength enough to say to his chief before he fainted dead away: 'It's done, sir.'

"As a result of his experience in that hell of heat the man was laid up in the ship's hospital for over a week. And to this day his sleep is constantly disturbed by dreams in which he is roasted in red-hot furnaces."

We are next told how this same engineer stood upon red-hot steam pipes when "repairing" a leaking valve while under steam pressure, and then of how another engineer pried open the stuck safety valve of a donkey engine boiler and thus prevented a hole from being blown through the ship's bottom—the stuck safety valve being located by an unusual noise!

We are also told that:

"It is only when a cylinder head bursts or a large valve gives way, filling the engine-rooms with scalding steam before the opportunity can be seized upon to repair the damage, that an engineer is forced to leave his post. Then it is that he has to charge for dear life up steep, narrow companionways, made slippery by engine oil, to a place of safety. And all the time he climbs upward the steam pursues him, for the companionways are in the only opening leading out of the engine-room.

"But it is not often that escaping steam gets ahead of an engineer, for he is a man trained to act like a lightning flash in emergencies."

It is lucky for all concerned that the engineer has been trained to sprint faster than steam can travel, but some inventor should invent a cylinder head that can be repaired, in case of an explosion, before it fills the engine-room with steam.

"And such instances," said the manager, "are almost of everyday occurrence."

Letters From Practical Men.

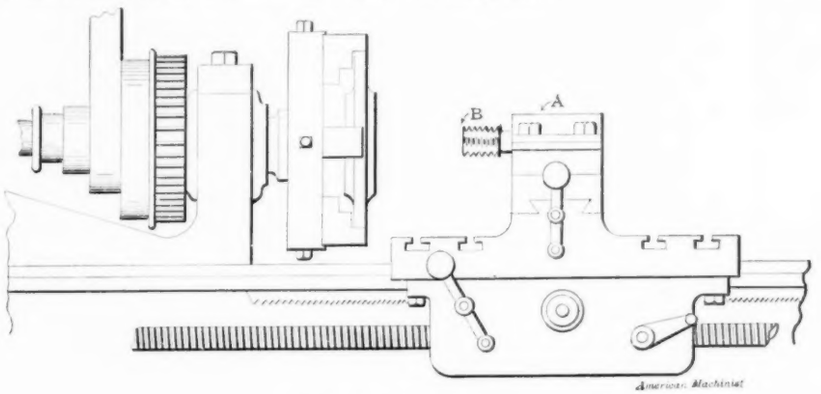
Threading Pipe Flanges.

Editor American Machinist:

I have just completed a pipe job which required a number of flanges ranging from 14 inches diameter of pipe to 5 inches; the flanges requiring to be faced, bored and chased.

Our first day's work proved to be very discouraging, due partly to the hardness of the iron, the chasing tool especially requiring frequent grinding. On going home that night I set about devising some means of expediting the job. After considering various impossible schemes which led into the realms of special machinery, collapsible taps, etc., the idea shown in the sketch suggested itself.

A is the fixture ordinarily used to hold a boring bar. I had a split sleeve made to fit this fixture and bored for the shank of the 2½-inch pipe tap *B*. The tap was then clamped in place as shown, with one of its cutting edges set at the proper



THREADING PIPE FLANGES.

hight, and the rig was ready for service.

I had anticipated some trouble in the larger sizes from the difference in the angle of the thread on the 2½-inch pipe tap and that of the thread to be cut, but no trouble developed from this source. About three traverses of the tap through the work were necessary to complete a thread, the flanges being bored to the proper size and taper before chasing.

The fixture *A* being bored in line with the lathe spindle and the pipe tap *B* being of the standard, ¾ inch per foot, taper, insures duplication as far as pitch of thread, shape of thread and taper are concerned.

The lathe was of course geared to cut 8 threads per inch, the same as the tap. It is also clear that the 2½-inch pipe tap can be used on any size above 2½ inches, as the pitch of all threads on standard pipe above that size is the same. It also obviates the necessity of a taper turning attachment other than the compound rest, as, after the hole is bored, the tap takes care of the tapered thread.

Another word as to duplication in pipe work. My practice is to fit the flanges so that they will screw on half the length of thread by hand. On a lot of 12-inch pipe it was found necessary to fit and mark each flange to its place, there being such a great difference in the threads, thus adding greatly to the cost of the job. C.

"A Report of a Meeting."

Editor American Machinist:

At page 453 I think you have done an injustice to the American correspondent of *Engineering*, in printing the letter criticising his report of the paper on "Gift Propositions for Paying Workmen," read at the December meeting of the American Society of Mechanical Engineers.

The letter says: "Your New York representative says that my paper 'was in opposition to the bonus or piece-work system.' The paper distinctly advocated the piece-work system. The report says that my paper 'contained imaginary conversations between the boss and the workmen.' The paper contained no conversation, real or imaginary."

I have a copy of the paper before me, and also *Engineering* of February 13, containing the report. The only inaccuracy in the report that I can find is in the use of the word "piece-work" instead of "premium" as a synonym of "bonus." This was clearly a slip of the pen, for in the rest of the report the writer of it uses the word "premium" in opposition to "piece-work," as in the following extract:

"Another argued that the piece-work system frequently showed that piece work based on day labor was too high, and that without cuts it was unpractical, so that the premium plan avoiding this was a satisfactory solution."

As to the "imaginary conversations," I enclose you the paper itself, in which you may see for yourself the imaginary conversations, in paragraphs 16 and 17. I quote:

"The proprietor might have said to the men: 'Here, you fellows are working all right,'" etc.

"Imagine the two men working. . . . 'Now, boys,' he [the boss] says, 'I know you won't object to raking in a little more cash every Saturday night,'" etc.

The author gives only the boss's side of the conversation, not quoting the workmen's replies, but it is a conversation, nevertheless, and an imaginary one.

The report in *Engineering* dealt with the paper itself in a very few lines, and contains chiefly a report of the discussion, together with the correspondent's own views on the labor question. I cannot find any incorrect statement in it, except the slip of the pen on one word, as above stated. The statement that the paper "seemed to rest on a series of assumptions rather than on experience" is strictly correct, as anyone who reads the paper may see. WM. KENT.

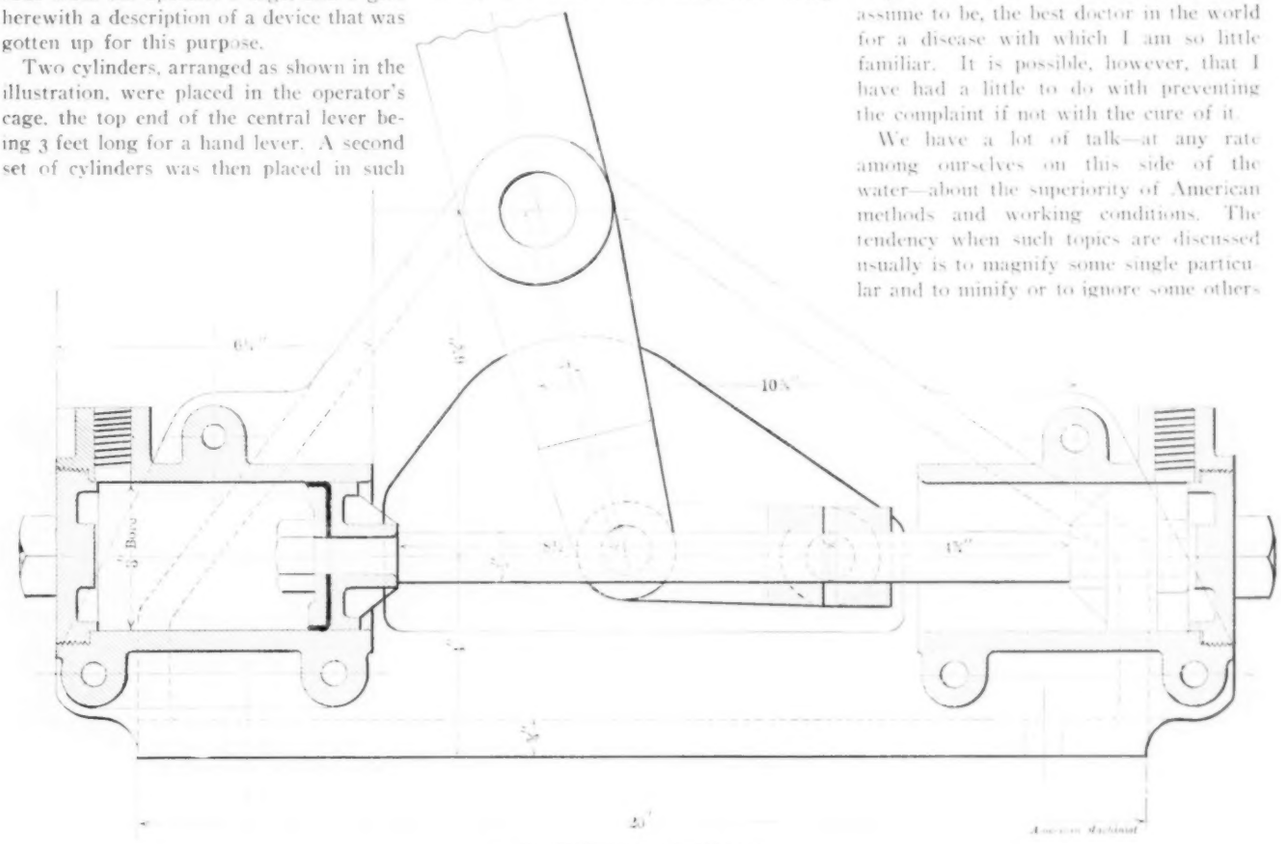
Passaic, N. J.

A Substitute for Reach Rods.

Editor American Machinist:

Some of your readers might be interested in a scheme to operate a lever that was in such a position that it could not be operated by a system of levers and reach-rods from the operator's cage, and I give herewith a description of a device that was gotten up for this purpose.

Two cylinders, arranged as shown in the illustration, were placed in the operator's cage, the top end of the central lever being 3 feet long for a hand lever. A second set of cylinders was then placed in such a position that the central lever could be connected directly to the lever to be operated. The cylinders in the operator's cage were connected by ¾-inch pipe to the cylinders at the lever to be operated.



A SUBSTITUTE FOR REACH RODS.

The system was then filled with oil, which could only flow from one set of cylinders to the other when the pistons in the first set of cylinders were moved. It will be clearly seen that for every motion of the pistons in one set of cylinders there would be a corresponding motion of the pistons in the other set, this motion being in the opposite direction from that of the first pistons; so that when the operator, by means of the hand lever, moves the pistons in the cylinders in his cage, he likewise moves the pistons in the other set of cylinders, which in turn move the central lever that carries with it the lever to be operated.

The oil system must be absolutely free from leaks, the connecting pipes and oil passages must be amply large and the pistons must be packed with first-class cup leathers, so that there will be as little resistance as possible to the moving parts.

ENGINEER.

Losing Time.

Editor American Machinist:

One who reads the AMERICAN MACHINIST faithfully cannot fail to notice the international complexion it is getting. It is no longer permitted to be the companion and instructor of the American shopman alone, its offices and influences being sought and availed of by the Englishman also, and this is in no way better and more welcomely evidenced than in the correspondence which is appearing in its columns from English contributors. This interchange of information, experience and opinion cannot fail to be to our mutual advantage. I hope that I will be doing good rather than harm if occasionally I venture to comment upon—sometimes perhaps even to dispute—what our transatlantic friends may set before us, my good will in the matter being none the less when I speak with my wonted plainness and freedom.

I was particularly interested in that letter at page 591 about "Losing Time." I must confess that it was quite a puzzle to me until I caught on to the English of it. The state of affairs as narrated, and told in such a transparent way that you are compelled to believe it, would be impossible to find anywhere in the United States. Why, I was foreman for eight years of a shop in an interior city employing about forty men, and certainly not one man a week would lose a quarter of a day in the way the "Junior Boss" tells about. Losing time at either end of the regular day is not a serious or troublesome fault with us. That it is so in England I have various items of information corroborative of the statements of the letter referred to, and it being so it is proper to discuss the causes and the possible cure for it. At the same time it is very evident that I am not, and I do not assume to be, the best doctor in the world for a disease with which I am so little familiar. It is possible, however, that I have had a little to do with preventing the complaint if not with the cure of it.

We have a lot of talk—at any rate among ourselves on this side of the water—about the superiority of American methods and working conditions. The tendency when such topics are discussed usually is to magnify some single particular and to minify or to ignore some others of perhaps equal importance. It will generally be found, I suppose, that good results or the reverse in shop management are produced by the co-operation of a multiplicity of causes, each deserving of consideration, and certainly not least among these must be the habits of workmen—the bad habits, we must call them—as thus brought to our notice. Besides the skill and reliability of the workman, as a workman and when at work, it evidently makes a great difference whether you have the

workman for all the working hours. It is not easy to set forth all the losses that ensue from the workman's losing time. There is, of course, the workman's loss of so much wages and the employer's proportionate loss of so much profit on the hours not worked, and sometimes we don't think beyond that. But there is evidently more than that. It is an actual loss to have the tools stand idle. We all understand they will be eating themselves up when idle for long periods of time; why not also when standing idle for shorter periods? Then it interferes with plans or prevents the making of plans if there is no telling when certain pieces of work can be depended upon to be done. There can be no reliable system which is not reliable all through. Every workman is necessarily a cog in a wheel or a link in a chain, and we all know how beautiful these things are when not complete.

Now, why such a difference of habits? As to the American, he does not lose time simply because he can't afford it. If you should try to entice him to go out or to stay out for a time in the morning or at noon or at any other time he would be very likely to give that as his reason. This is curious, too, when we all understand that the American earns the biggest wages, and therefore might be assumed to have rather less need of each least, last penny of it. But he has a definite use for every cent of it, and as the employer's plans would be deranged by his losing time his own plans would be impaired at the same time. Hasn't the Englishman just such a use for all his money, and has he no plans of life to be interfered with? Is a quarter of a dollar worth more to an American workman than a shilling is to an Englishman? It would seem so, since the shilling will not pull the Englishman out of bed as the quarter of a dollar draws the American. The remedy would seem to lie, then, in increasing the Englishman's appreciation of the shilling. If you can't do that I don't know where the remedy lies. The trouble evidently is not to be cured by increasing the wages or by promises of small pecuniary rewards for good behavior, and I don't wonder that the poor little "quarter club fund," with its penny fines and its shilling annual rewards, the latter for the good and the bad alike, which "Junior Boss" tells about, should have proved a failure. There is a vast difference between offering a man more money or in making all money worth more to a man. The latter is what the English workman most needs, and I am not wise enough to suggest how it is to be put into him.

I suppose of course that there is a great difference in shops and in shop managers, and also in the prevalence in different shops of the state of affairs that our correspondent deplores. It would certainly be wise to study the best as compared with the worst, and to look for the causes of the difference. As I said at the beginning, we in the United States are incapable of advising in this matter, as we have so little experience with it, and my talk is purely theoretical. It does seem to me that something could be done with the apprentices, not by fines or rewards, but by absolute insistence upon their keeping time as a condition of remaining in the works. There are boys in plenty, and a heroic sifting of them should benefit the individual shop and should have an influence not bad upon those outside of it. An apprentice who gets out of his time without having at all acquired the slack habit has a good start for the rest of his life. But for the apprentice or the journeyman the influences to be sought and the conditions to be established are those which will make life more worth the living, and money more worth the earning.

TECUMSEH SWIFT.

Jigs for Planing Lathe Tailstocks.

Editor American Machinist:

Satisfaction is sometimes said to be worth more than money, and I don't think there can be any place where this will hold more true than in a machine shop. Nor are there many things more disagreeable than that a mechanic with good ideas must work in a machine shop that is badly managed by some so-called office man or a jealous, conceited, would-be machinist.

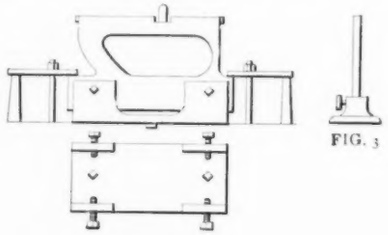


FIG. 1. THE OLD JIG.

FIG. 3

I know any good machinist will agree that he would much rather work for less money for a boss that gives him some credit for what he does than to be working for someone that can't tell when he is getting good service.

The above remarks are caused by a case coming to mind where a planer foreman that wished to make jigs, etc., to cheapen and simplify the work for a boss of the latter kind, was not allowed or encouraged to do so. He therefore took a job in another shop on the same line of work where the boss was a good machinist and could see from a sketch when you had a jig that was worth something. This foreman, after having made a few jigs that proved to be money savers, was allowed the satisfaction of making and seeing at work all the useful jigs and tools he wanted without even consulting his employer. But when a jig was to be a costly one he would get the consent of the boss first.

There are several things a foreman must consider when designing jigs if he would avoid having the boss kick and say "no" to his ideas, or tell him to let it wait a while. The first thing is to show that the jig will not cost much, that it will save time and that it can be used by a boy or cheaper labor. It would also be wise to show that the jigs can be made without interfering much with the regular work. In the sketches will be seen two different jigs for holding a lathe tailstock top piece. Fig. 1 is a jig the new foreman found when going into the shop. There are six set-screws in this jig. Sticks were placed in the cored hole of the tailstock and centered; the casting was then placed in the jig and adjusted by the screws until the centers stood level and in line crosswise. This required the use of sticks, chalk, dividers, surface gage and rule—to say nothing about hunting up bolts, clamps and blocks and the time taken in setting the job. There were six of these jigs used at a time; and, as there were four sizes of tailstocks and six jigs for each size, twenty-four jigs were required.

In Fig. 2 is shown a jig for the same job the new foreman made. There were six of these that did the work much easier

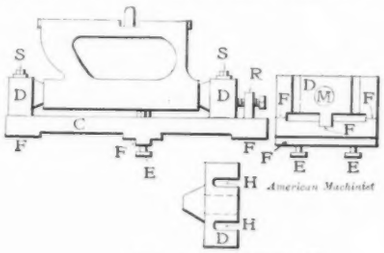


FIG. 2. THE NEW JIG.

than the other twenty-four. *C* is the bottom piece and *D D* are two cast-iron blocks with large case-hardened centers set in them. It may be seen that the pattern work was very simple and the machine work was the least there possibly could have been. The bottom piece *C* was planed only on the strips *F*. The blocks *D D* were first drilled at *M*, then placed on a shaft and the tongues planed central and the strips at *F* trued up; the slots *H H* were cored. Holes were tapped in the bottom piece *C*, at the proper places for the screws *S S*, so that the jig could be adjusted to the different sizes of tailstocks, and a hole was also tapped for the stop or jam screw *R*. The tailstocks were placed as shown on the centers, swung up level on top and butted against one another, the first one being stopped with an angle plate. The jigs were held in place by bolts *E E*.

In planing the tailstocks two heads were used, and Fig. 3 shows a handy hight gage for setting the planer tool standard. It consists of a base with a thumb-screw which base is bored out to receive a ½-inch cold-rolled rod. The rods are let through the base to touch the table. In planing the small size tailstocks twelve jigs are used and the time saved over the

old style of jig is remarkable. The cost of all the new jigs was less than the amount paid for the scrap iron in the old ones.

H. L. CAMERON.

Cutting Cams on the Milling Machine.

Editor American American:

The drawings show an interesting piece of work performed on a plain miller. We had a number of cams to cut and they had to come off the machine finished without requiring any hand work whatever, as it was most important that they should be duplicates of each other. Fig. 1 is a plan of the machine, and Fig. 2 an elevation. *W C* in Fig. 1 is the cam, one side being shown cut and the other side blank, the shaded portion between representing involute teeth. Fig. 3 shows the shape of the cam when laid out flat. It is composed of two curves joined with a straight line, thus making it impossible to arrange a train of gears to cut it as a spiral.

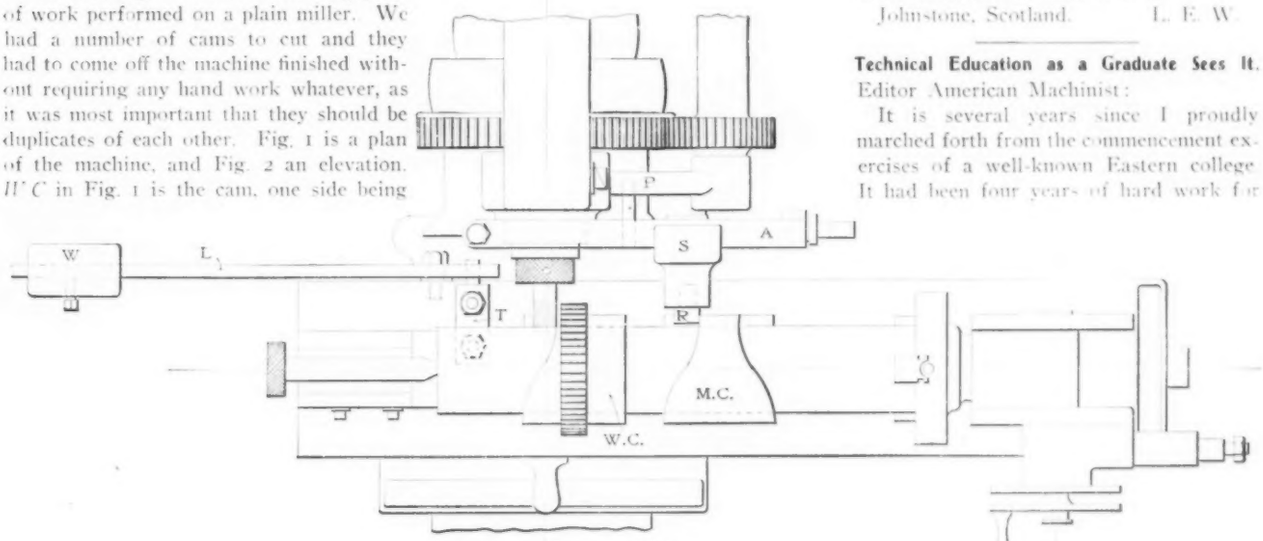


FIG. 1

FIG. 3

FIG. 4

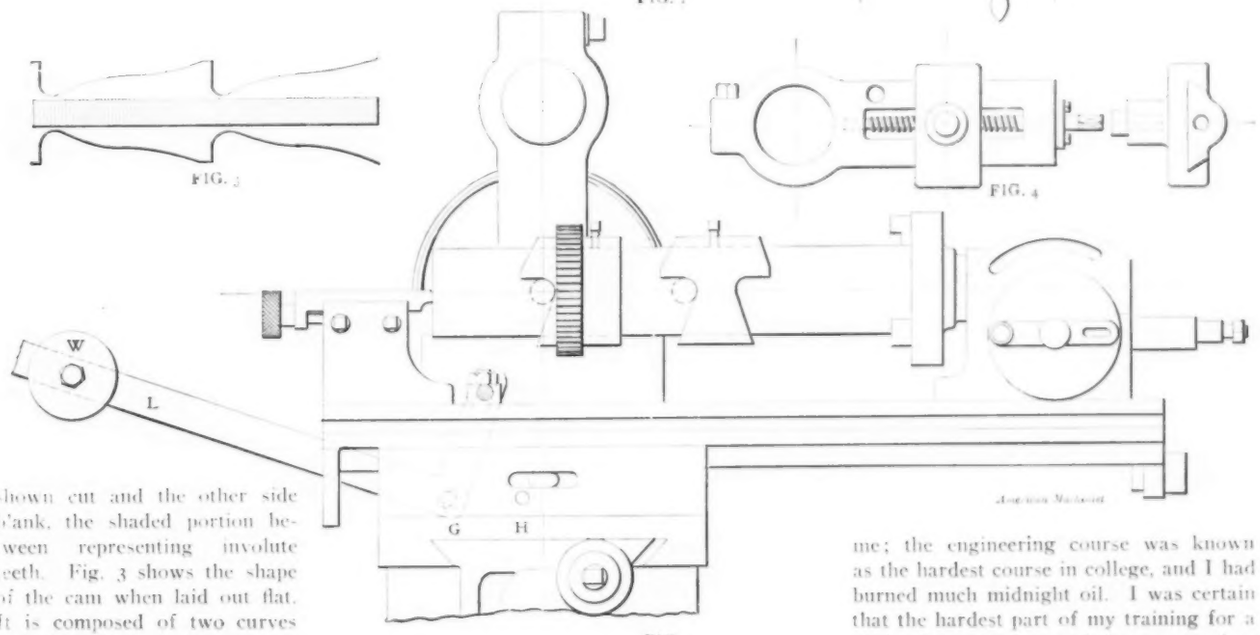


FIG. 2

CUTTING CAMS IN THE MILLING MACHINE.

A sleeve *M C* was turned to the dimensions of the cam blank. A very thin paper tracing was then made of the cam outline, Fig. 3, and fixed tightly round *M C*, the shape being marked round the periphery with a center punch. It was next machined out and filed very carefully to the marks, and used as a master cam. As the drawings show, *M C* and *W C* are both fixed by screws to a mandrel which is held by the dividing head chuck and the center. The screw was taken out of the table. Fixed on to the nut for adjusting the front bearing is a split arm *A*, shown at Fig. 4, which carries a small slide *S* traversed by a screw. In the slide is sunk a roller *R* which is free to turn. *P* is a pin fixed in the machine to help support *A*. To the cross-slide of the miller at *G* or *H* is fixed a bent lever *L*, the pin acting as a fulcrum. At one end is an adjusting weight *W*; the other end is slotted and engages with the turned portion of plate *T* which is bolted to the top of the table. It will be noticed that by the movement of the lever the table can be moved. A roller of 1⅛ inches diameter rolls round the cam when at work, so a 1⅛-inch end mill was used for the cutting of the cam. For the same reason *R* is 1⅛ inches diameter. The method employed while cutting is as follows: Traverse *S* until *R* is at the bottom of *M C* and the cutter begins to cut *W C*. Now rotate the mandrel by the dividing head handle until the cutter runs off *W C*. Put a new cut on by adjusting *S*, nearer the cutter, in this instance. Continue moving *S* and turning the mandrel until the proper depth has been cut. The lever *L* and the weight *W* keep *W C* against the tool and *R* against *M C*. One side of the cam is cut with *L* pivoted at *G*, as shown, and the other side with *L* at *H*.

Johnstone, Scotland. L. E. W.

Technical Education as a Graduate Sees It.

Editor American Machinist:

It is several years since I proudly marched forth from the commencement exercises of a well-known Eastern college. It had been four years of hard work for me; the engineering course was known as the hardest course in college, and I had burned much midnight oil. I was certain that the hardest part of my training for a profession was over, and that my services would be greatly in demand. After much perseverance I succeeded in obtaining a position in the drafting room of a large and prominent concern, but at such a salary that I hardly knew what day "the ghost walked." That was my first bitter lesson in the practical world.

Just a word about that M. E. degree. After a very brief association with the skilled and ingenious men among whom I worked—some of them grown gray in their profession—I ceased writing the two letters after my name and requested my correspondents to do likewise. I hold that no college or technical school has any right to grant engineering degrees. No

man without years of practical experience and a showing of marked ability in things mechanical should aspire to such a title. Institutions should not cheapen such a high degree by granting it, and I am glad to note that my Alma Mater has recently decided to give no more M. E. or C. E. degrees; instead, Bachelor of Science in Mechanical or Civil Engineering.

I do not believe that the contributors on technical education understand how little time, comparatively, the student spends in the drawing room. Twelve hours per week is the average. Nor do I believe that either the professors or the students realize how valuable this time is when the lessons learned in the class room should be given severely practical application. From start to finish the student should be shown how to apply the facts, formulas and methods he studies. Let him spend no drawing-room time in laying out complicated geometrical figures merely to teach him accuracy in making "pretty" drawings with no pinholes through the paper. Teach him accuracy and neatness in something which will be useful, and thus use the precious hours from the start to the best advantage. It is usually well into the second year before the student does anything in the line of machine drawing. He has made all sorts of drawings in projection, perspective and shades and shadows; he has "passed planes" in all four quadrants, and has found the curious curves when one solid intersects another, etc.

With a sigh of relief, he is glad, about the middle of his sophomore year, to take up machine drawing. He is usually given a simple piece, like a steam valve, to make details and an assembled view. Here, again, in his effort to make his drawing "pretty" he loses sight of its practical significance.

The third and fourth years in the drawing room are usually given to advanced machine detailing and assembling and machine design. Here, too, the teacher too often neglects to point out the practical points which must always be taken into account in later years. In drawing details, the most important fact that the parts shown and dimensions given are for the patternmaker, the molder and the machinist, is lost sight of, just as it was in the first simple work. The student does not know the value of rounded corners and fillets, and his greatest fault is usually in giving measures, especially those indicating finished surfaces. In this one place, the student's lack of training in practical considerations shows itself more than in any other. Another common fault is that the value of clear dotted sections is not appreciated either by teacher or pupil. The course in design usually consists of problems given out by the instructor, in which the forces are to be calculated and the parts designed from formulas learned in mechanics or taken from some work on design. While this is well enough, the student fails to learn that more often than otherwise acting forces cannot be ascertained, and when later he has such problems to tackle, he effects rather amazing results in trying to make the pieces "look" right and in proportion to themselves and to the amount of work they must perform.

There is another very important lesson that is so apt to be left untaught, and it is that of *making a start,* of putting down on paper the facts in hand, if these facts are represented by only two or three lines. The student often spends hours in trying to see all the details of his design, instead of working along step by step, forgetting that he is wasting valuable time and getting farther away from the desired result.

There are plenty of other courses outside the drawing room which the young aspirant must pursue. For instance, he goes far into pure and applied mathematics during most of the four years, and although he may never again have occasion to use his Analytical Geometry or his Integral Calculus, I believe mathematics invaluable in developing the reasoning powers. He also gets an insight into one or two foreign languages, and they afford a pleasant diversion from the regular routine, aside from their intrinsic value. They should not be omitted.

Besides his drawing and his studies, the engineering student has work in the shops, makes tests on the strength of metals, boiler tests and steam engine tests. The shops are usually in charge of practical men, and although there is much room for improvement in their equipment, the student usually receives very important instruction here. It should not be expected to turn out skilled workmen, for the average time that can be spent in the shop is but six or eight hours a week, and the course does not often begin until the second year. However popular opinion may differ, the technical student at school or college has no time to idle away. If there is one thing I would have emphasized in the shop more, it is the course in pattern-making and molding. If the pupil has not time for a thorough course in this himself, let the instructor give lectures with practical illustrations. Next to the student's doing the work himself, illustrated principles are the most valuable aids to memory, and this important branch should not be neglected. The student should not only learn how to work the different metals to the best advantage, but when and where to use them. Show him the assembled drawing and sections of a machine construction, some rather common contrivance, and require him to state of what material he would make each part, and why, noting that some parts should be case-hardened, some tempered, some ground for fits, etc. Under an up-to-date instructor, either in the drawing room or the shop, much valuable information could be stored away in this manner. The boiler and steam engine tests are usually well conducted. Here, at least, the student is dealing with reality; but I sincerely doubt if he does get a lasting or accurate idea of the strength of materials by breaking specially prepared specimens in elaborate tension, compression and torsion machines and plotting curves for results. Simple contrivances, where the load could be applied in a visible way, would, to my thinking, prove more beneficial.

Taking the course as a whole, then, we find that the two most important errors that keep recurring the whole four years are those of neglecting to descend, whenever possible, from the theoretical to the practical, and of teaching the value of time. It is a general fact that the student is allowed to pursue each study in an abstract way, rarely being taught, and more rarely finding that "there is nothing new"; that one subject is built upon its predecessor, and that he is only advancing step by step into a wider realm of thought and reasoning.

It has been my purpose here to offer criticisms and suggestions only. Much can be said in praise of college technical courses. Without doubt they are growing better each year, and are turning out better trained young men, who are being sought after. May the time soon come when the theoretical and practical side of their training shall be well balanced.

GRAD.

A Practical Use for Discarded Tin Cans.

Editor American Machinist:

I was much surprised and greatly interested a few days since, when shown through a certain establishment near New York city, to find that the "raw material" used consisted chiefly of empty fruit and vegetable cans rescued by the cartload from the dumps of the city. I had supposed, up to that time, that the only purposes for which such material was suited was food for goats or to be attached to the tails of unfortunate canines.

The principal products of this establishment, which is a foundry, are window-sash weights, elevator weights and ballast for boats. The weight castings are very hard and, when struck with a hammer ring, like steel. About the only tool which can be used for removing sprues and fins is the hammer, as a cold chisel or file will not stand up to the work. The fracture of the round sash weights is smooth, and shows crystals radiating from the center like spokes of a wheel.

After delivery at the foundry the cans are first piled upon a large iron grating, located under a sheet-iron hood which terminates in a smokestack. They are sprinkled liberally with crude oil which is set on fire. This process consumes the labels, loosens the dirt and melts the solder, which falls through the grating, is collected, washed and melted, cast into ingots and sold to be used again.

Some of the cans, which have simply lapped and soldered joints, melt apart

completely; these are sorted out and the sheets forming the shell are straightened and bound into bundles to be sold to trunk makers, who utilize them for protecting the corners of Saratoga trunks. They are also bought by button manufacturers, who stamp from them the disks used in cloth-covered buttons.

The remainder of the cans, being machine made, do not come apart. These are loaded into large carts, taken to the charging floor, on an elevator, and dumped into the cupola. The cupola is fed with coke and cans in alternation. There is occasionally an old wash-boiler or a bundle of tin roofing used, but cans form the bulk of the material. The cans are so light that some of them are carried out at the top of the stack by the force of the blast, and a large screen has been arranged to prevent the pieces from falling on the roof.

If among those readers of the AMERICAN MACHINIST to whom these facts are new, there are any who have occasion to use the elevators in the skyscrapers of New York, I can imagine such wondering how many empty cans it took to make the weights which balance the car in which they ride. 23—1—13.

A Compound Piercing Die.

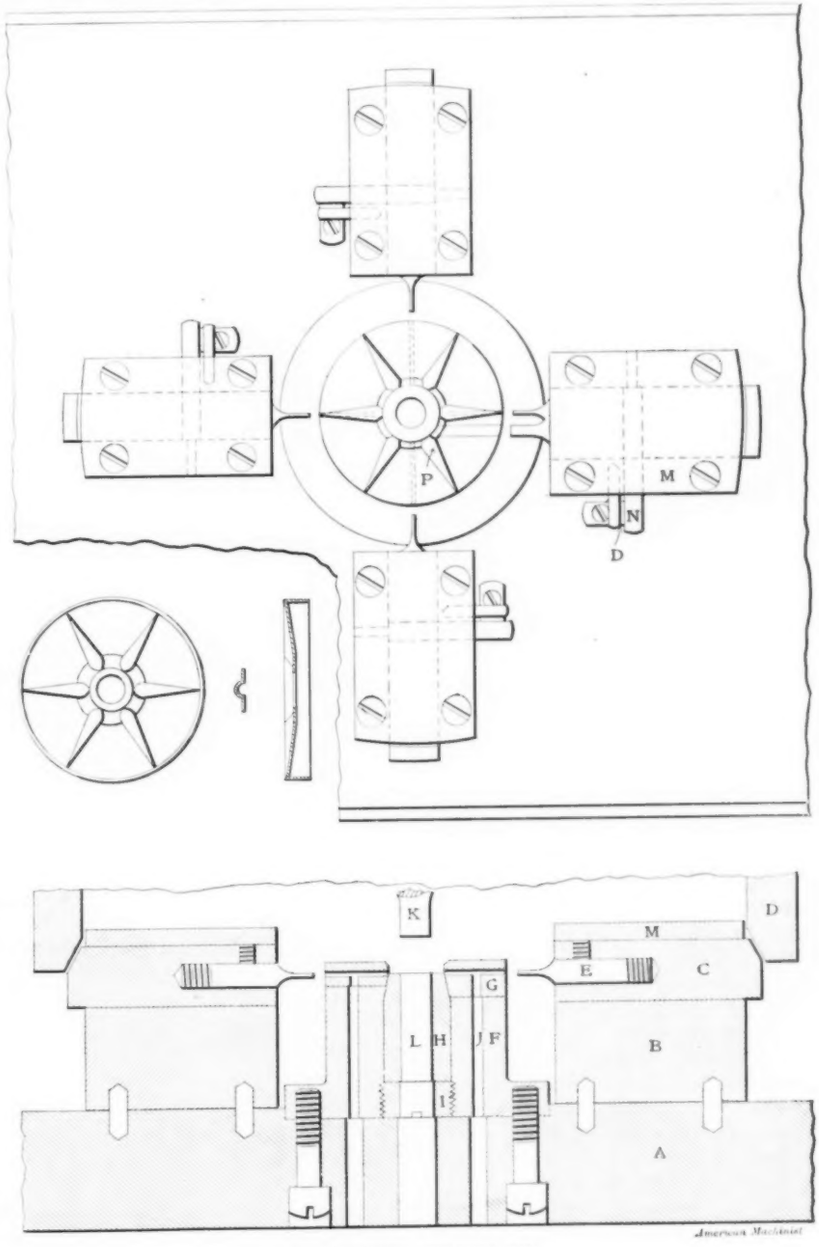
Editor American Machinist:

The sketch shows a compound piercing die for piercing a series of holes laterally in the shell of the punching *A* and also a single hole in the center. The drawing and forming die to produce this punching was the subject of a previous article at page 879, Vol. 25. As will be seen, the punching is an aluminum shell ¼ inch deep and 1⅞ inches diameter, and has a six-pointed star raised from the bottom.

In designing this die, it was necessary to combine accuracy and long life, as it was an expensive and delicate thing to repair. The reader will find therefore that all cutting edges have provision for wear. There are five holes to be punched on the sides, and this is accomplished by a cam arrangement. *D* is a cross section of a beveled ring set into the punch plate. It was made in ring form to insure more accuracy in setting the die, and it acts as a guide for the central punch. It is bored to a running fit for the lug blocks *B* and is timed so that when the slides *C* are driven in, the punch *K* is just entering the metal.

E is one of the punches which are arranged so that they can be taken out and ground and put back, adjusting them for length by a thread cut on them, and holding by a blind set-screw. *G* is one of the dovetailed bushings, let into the die. This one is larger than the rest, as it has two holes let into it. The other three are all of the same size. The holes are reamed from the back, and the punchings fall down through the clearance holes *J*. Although we had no trouble with any sticking of the punchings, we drove pins in with one side beveled right over the clearance holes, thus preventing any chance of it. *H* is the central bushing or die for the punch *K*, and is supported by a screw *I* with a clearance hole.

Now, when *H* gets worn on the cutting edge, it can be taken out and ground, and adjusted by the screw *I*. In doing this it throws out the dovetailed blocks *G* by means of the taper on the upper end of *H*. These can in turn be ground very easily, and when done the die is again in condition to work perfectly.



A COMPOUND PIERCING DIE.

In the plan it will be noticed that in the slide supports there is driven a small steel pin, and also in *B* there is a pin *N*. When the punch is let into the die, the pin *N* advances with the slide, there being a slot cut in the support to allow the necessary play. This bends the spring *O* against the pin in the slide support, thus delivering enough stress, when free, to return the punch to its initial position. The spring is simply a piece of sheet steel, tempered when bent, and screwed to the cast-iron base plate in proper position.

J. W. WHITE.

First Aid.

Editor American Machinist:

A thing needed in all works where machinery is used has been started by the firm of Taylor & Son, Kings Cross, London. It is an ambulance class for rendering first aid to employees that get injured while at work. In the first place, this firm pays for suggestions made by the workmen; and an ambulance outfit was suggested by one of the workmen a few weeks back. In a very short time the

necessary things were obtained, and then it was for this man to get a class together. This was quickly formed, and a first-class instructor from the St. John's Ambulance Associations was obtained. Every Monday evening the class meets at a local Board school for instruction, and every Friday evening they meet at the works canteen to be coached in their previous lesson by the man who organized it, he having had previous experience. The firm are enthusiastic in the matter and have offered prizes to workmen who obtain certificates. This might be of assistance to a great many firms not yet equipped with provision so essential for the betterment of their workmen in everyday life.

E. J. TOWNDRON.

Leytonstone. England.

A Rig for Drilling Machines for Locating Holes.

Editor American Machinist:

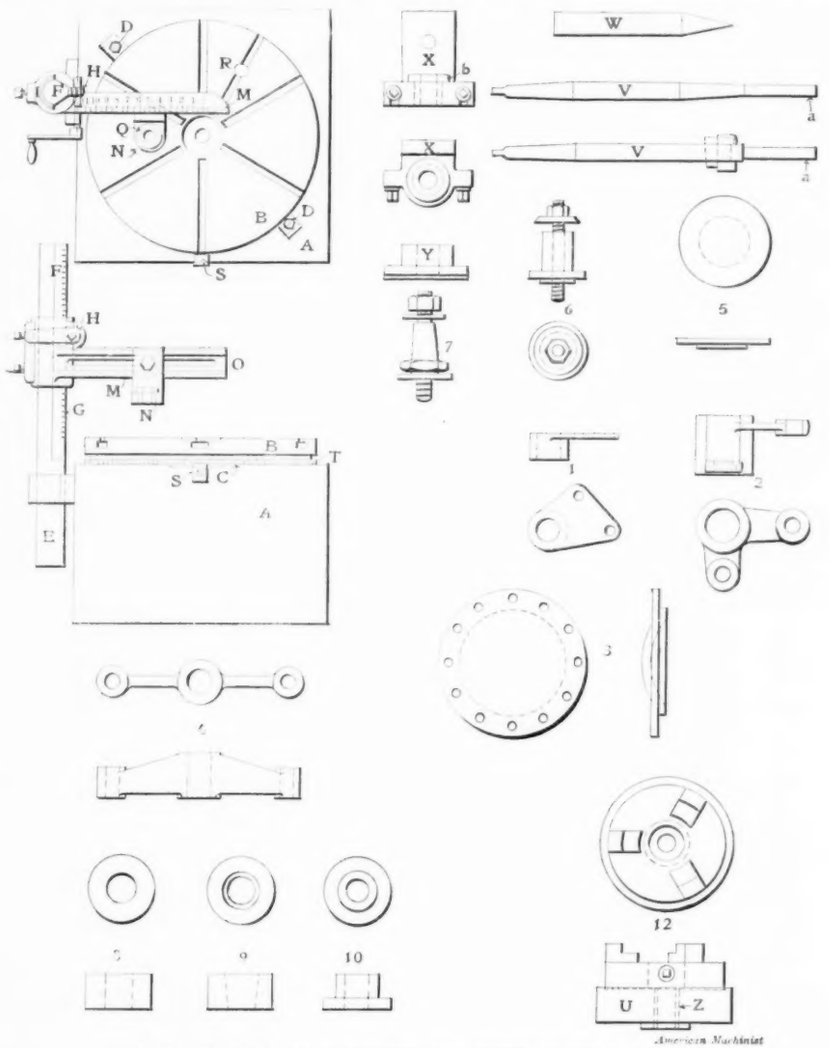
The sketches show an arrangement that may be used with an ordinary radial drilling machine when holes have to be drilled with accuracy in a large number of pieces, say, at a certain distance from a center or from a finished part, saving either the time of laying them out or the time of making expensive templets. It is in fact an adjustable templet that can be set in no time to suit pieces of any kind, and by its means the difficulty that the drill hand finds in drilling a hole exactly as laid out, the possibility of mistakes, and all the trouble that often arises when in assembling an engine the holes don't meet are eliminated.

A is a base on which is fitted a face-plate *B* that turns about the fitting *C*. This face-plate, that may be set on rollers, is graduated and can be set at any desired point by tightening the bolts *D D*. At the side of base *A* an upright bar *E* is secured. This bar is V-shaped at the front *F*, and at the apex a rack is cut, on which is engaged a small pinion *H*. On the end of this pinion shaft is a handle by means of which the arm *M* can be brought to any hight. This arm slides on the bar *E*, and when at the right place can be secured by set-screws, as shown. On the arm is a sliding piece *N* that can be tightened at any place required. The bar and the arm are set perpendicular to the face-plate, and the center of the hole *Q*, in which are fitted steel bushings of the different diameters of the holes to be drilled, coincides with the center of the face-plate when piece *N* is placed at zero.

Pieces of the type shown at 1, 2, 3, 4 can be machined, using the fittings shown at 5, 6, 7, that fit in the center of the face-plate. The arm *M* is graduated as shown, and the piece *N* can be set readily at any radius from the center of the face-plate. The pointer *S* and the graduation at *T* make it easy to turn the face-plate any given angle, and give to the holes to be drilled any needed spacing.

This arrangement may be used also for doing simple operations of boring straight and taper holes, and facing. For this purpose a universal chuck is fitted on a base *U* (see 12) in the center of which is a bushing *z* that acts as guide for the boring bars *V V*. The base is fitted in the center of the face-plate. In place of piece *N* is put *X*, that has a bushing *b* that acts as guide for the upper part of the boring bars.

If taper holes are to be bored or facing done, on pieces of the type shown at 2 and 3, for crank pins, etc., the piece *Y* may act as a guide for the bars. The pieces are first put on the fitting 6, and all drilled. Then piece *Y* is placed



A RIG FOR DRILLING MACHINES AND TYPES OF WORK FOR IT.

in hole *R*, Fig. 1, and, using the same fitting 6, the pieces are placed on *Y* for the tapering and facing operation. The pointed plug *W* that fits in *Q* may be used for setting these pieces centrally with *Y* and *R*. In drilling holes whose centers are laid out, the pieces are bolted on the face-plate, and, by means of the plug *W*, the center of the hole to be drilled is brought exactly in center with guiding bushing *Q*. This insures precision and renders perfectly unnecessary the use of the center chisel. This rig has been used with perfect satisfaction.

I. M. MENEGUS.

Fire From an Electric Spark.

Editor American Machinist:

I would like to call you attention to a queer condition that may interest some of your readers.

A small blaze in the wood shop of the Searchmont Automobile Company, Searchmont, Pa., was caused, apparently, by a spark of frictional electricity generated by a fast running belt rubbing against an iron belt shifter in the wood shop.

The pulley is an 8-inch loose pulley on a single surfacer, running at high speed. Considerable fine dust had collected on the inside of the rim of the pulley. The end of the shifter iron was about ¾ inch from the edge and rim of the pulley, and upon investigation we found that a large white spark would flash every second or two from the shifter to the pulley rim, which spark we must conclude, ignited some of the fine dust on the inside of the rim. It was discovered immediately and extinguished. The pulley bearing was normally cool and well oiled, and the flame could not have been caused from a hot bearing. We have remedied this difficulty by bending the shifter arm further away from the pulley

rim and now have no spark. The matter seems almost incredible, but we can find no other explanation. If a flame can be caused in this way it seems that there may be another danger to guard against in cotton mills and wood shops, where high speed machinery is used.

Regarding the spark, it must have been of high potential to jump ¾ inch, and seemed to be as large and hot a spark as we get from a battery to ignite gas in our engine.

C. W. ROWE.
Ass't Superintendent.

Legs of Machine Tools—Improving a Steam Pump Valve—A Governor Shaft Bearing—Gas Engine Piston.

Editor American Machinist:

In the course of a dozen years or so in the business I have run across a few things which did not seem to fill the bill anywhere near as they probably were intended to. These occurrences have generally brought their lessons with them, and some of them may be of interest to AMERICAN MACHINIST readers.

A big horizontal boring and drilling machine had to be moved from one part of the second story of a big factory to another. The machine had a fairly deep bed and it rested on a cabinet at each end, with a short leg in the middle of its length; that is, it was supposed to. All the legs had holes for bolts or lag screws, and of course the man who had placed the machine, being very conscientious I suppose, saw that all the lag screws were properly put in; what else would they put holes in them for? So when about to move the machine they took out the lag screws. The bed of that machine was probably 16 feet long, and when the screws were out the floor was away from the middle legs about 1¼ inches. Of course the floor had settled! Did you ever see a floor that didn't settle. I don't think the machine itself sprung that much; it merely acted as a beam to hold up the floor some, as both ends of it were pretty close to columns.

Well, the machine had to be moved; business was rushing, heavy loads had to be moved over the floors frequently, and more machinery was being crowded in right along; if the floors were overloaded they would have to settle, that's all. The heaviest work ever likely to be put on the machine would hardly strain it as much as that floor did, so we left off the middle legs entirely. It was at first proposed to move the cabinets in toward the middle about 2 feet at each end, but that would look like ——. To even up matters we put a narrow strip of flooring crosswise under the inner end of the head cabinet, and a similar piece lengthwise under the middle of the inner end of the tail cabinet; this gave us a three-point support, and when leveled up the machine stood surprisingly rigid, and we did not use any lag screws either.

When I look over the advertising columns of the AMERICAN MACHINIST and see a deep, massive, modern-looking planer or other tool, that looks for all the world as though it ought to stand up and do business on one pivot, I wonder why it is encumbered with four, six or even eight feet, particularly when most of them go on to just such floors as I have mentioned.

. . . . . .

We had a kick from the soap factory that the steam pump we had overhauled a few months ago was blowing "just as bad as ever." I had done the job myself and was positive the work had been properly done; so it was up to me to go and look it over. It was one of those early double-acting pumps, the main steam valve actuated by an oscillating piston valve, the arrangement looking something like Fig. 1. As will be seen, the lug on the slide valve,

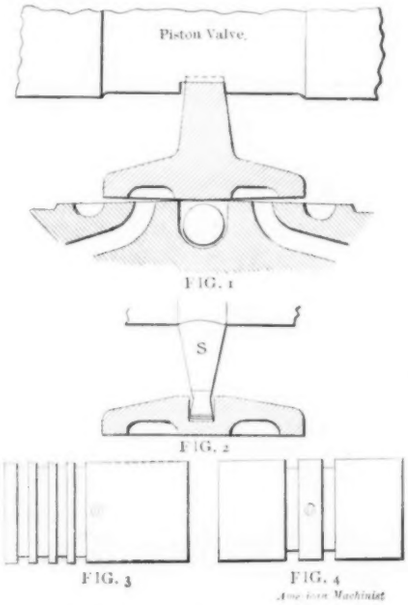


FIG. 1

FIG. 2

FIG. 3

FIG. 4

IMPROVEMENTS MADE IN A REPAIR SHOP.

acted on by the piston valve, was quite high from the valve seat face, where all the friction and resistance to motion was. As the valve was comparatively short, and the seat nearly all port holes, it did not take long before both valve and seat were worn as shown, somewhat exaggerated. Fig. 2 shows how we fixed it. We sawed the lug off entirely and milled a groove in the back of the slide valve. A stud was fastened to the piston valve as shown, the lower end fitting loosely in the slide valve. This brought the line of pressure pretty close to the resistance. As the piston was comparatively long, it stood the extra wear without trouble, and "it was a good pump ever after."

. . . . . .

A governor was brought in from the country to have a new shaft put in and the bearings babbitted—and they needed it. The shaft made an angle of about 15 degrees from its original position. The pulley had been about a foot away from the single bearing, which was only 6 inches long. That is the way most of them run, only some are worse. To get an extra bearing near the pulley we drove a piece of tubing (an old flue) over the stem; this was babbitted and a brass bushing was put in the flue near the pulley. As we turned and polished the flue before putting it on, it made quite a neat job. We always keep an assortment of flues handy, as they can often be used where a pipe won't fit.

This reminds me of a case where a firm I was working for bought a big screw machine second hand, and among other things wanted for it was a tube for the draw-in chuck. They made a big gun drill and a nice squirt gun and got a big bar of steel in the lathe and went at it. In about a week the job was done, and when the Old Man sized it up he found that it had just the dimensions of a 2½-inch flue, about 42 inches long, which would have answered just as well; and he was so mad about it that he had it hung up in the drafting room and used a piece of flue instead.

. . . . . .

The gas engine in the sausage factory got "that tired feeling," and did not want to work when the load was heavy, so they sent to the shop for the doctor, to see what was wrong. It was a good sized engine, about 20 horse-power, and I found the compression was bad. By smearing a lot of thick oil in the cylinder I could keep it running as long as the oil lasted, but then it would begin missing explosions, and finally would stop altogether. It was one of the new (?) kind, in which the piston is expected to serve as a crosshead also. This piston looked something like Fig. 3; the pin was in the middle of its length, and to make sure there would be no leakage, they cut four nice wide grooves in it for packing rings and put them all on one end. This cut away about two-thirds of the bearing surface on this end, and what was left could not be expected to last very long. The piston measured ⅛ inch smaller up and down at the back end, and the cylinder was cut up some also. The only thing to do in a case of this kind is to rebore the cylinder and make a new piston. We made the new piston like Fig. 4, with a groove on each side of the pin and two rings in each groove. The rings were made as deep as could be sprung in place; in this case 7-16 inch for an 8-inch piston. I've noticed a good many gas engine pistons made in just the way this old one was, and some of them, and also some air compressor pistons, with the pin even nearer the back and grooved end, presumably to get a longer connecting rod. This is very bad practice, as a gas engine piston that does business as a crosshead will cause trouble soon enough under the most favorable conditions. In advanced practice the pin is located nearer the front end, so that the wear will be more evenly distributed.

GEO. J. MEYER.

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The Post Office vs. the Courts.

We note that the courts have enjoined the Post Office Department from the issuing or maintenance of a fraud order against a manufacturing concern in Boston, regarding whose methods of doing business some complaints had been made. The manufacturing concern in question claims that a fire in their plant had prevented them from filling orders as promptly as some of their customers desired and that this is what caused dissatisfaction, led to the complaints, and finally to the issue of the fraud order. Whether this claim is true or not it is quite certain that no business enterprise ought to be placed entirely at the mercy of the Post Office officials, who, like everyone else, are liable to be mistaken and a mistake in such matters is a rather serious affair. It is not right that a citizen of the United States should be convicted of fraud and his business ruined except in the manner provided by law; that is, he should be convicted only by a formal trial before a jury and with a chance to defend himself.

It is somewhat curious, by the way, that we hear of so many fraud orders issued by the Post Office and the stoppage of the mails to concerns suspected of irregularities, when at the same time it seems impossible to secure any such action with regard to the Cleveland oil swindlers, who are notorious frauds and can be demonstrated to be such very easily. These fellows seem to be able to continue the use of the United States mails, although the attention of the authorities has been repeatedly drawn to the fact that they are using the mails for nothing else than to help them in their swindling operations.

The trial of Engineer Wisker for manslaughter for his part in the famous tunnel collision on the New York Central Railroad, has resulted in his acquittal, and as to the propriety of this verdict we think most fair-minded people will agree. The fact that other engineers have made thousands of trips with trains through this tunnel in safety does, of course, prove that it can be done by means of extreme care and watchfulness, but it does not prove that the conditions are all that they should be for the safe running of trains, and though it seems to be the fact that Engineer Wisker was not the most efficient possible man to be in charge of a locomotive, yet it is doubtful if a man can or should be held legally responsible for lack of personal efficiency. If he is trusted with responsibility by those who have the power to impose responsibilities it is questionable if he is under obligation to decline those responsibilities on account of his own consciousness of unfitness for them and where an engineer places himself at the head of a train he certainly takes at least as much risk as any passenger in that train, and it is to be assumed that he will have a care for the safety of a train under conditions where, if an accident occurs, his own life will be more likely to be forfeited than that of any other. It would seem that such an assumption of risk is all that society ought to require of a locomotive engineer. The conditions of the tunnel in which the accident happened were caused by a desire to economize, to save money and to pay big dividends. All these conditions could have been avoided by the expenditure of money and those who were responsible for this failure to spend money for that purpose are being made to suffer by means of damage suits in which some record breaking awards have been made. We hope such awards will continue to be made and that the lesson in false economy will be as thoroughly taught as possible.

The idea of some sort of combination against the importation of American goods into Europe seems to pervade a good many European minds and the press despatches now announce that in Vienna certain German and Austrian economists and manufacturers are planning the formation of a Central European Association for the purpose of fighting against the introduction of American goods. Of course this can mean only one thing and that is that certain American goods are produced by means of our machinery and improved methods at lower rates than an equal quality of goods can be produced in Germany and Austria and that these goods are desirable to citizens of those countries and will be purchased by such citizens if they are allowed the liberty to do so. There can be no reasonable doubt that the welfare of the majority of the citizens of those countries will be secured by liberty in such matters and it is equally certain that those who contend for the restriction of this liberty are seeking their own interests only and are not working upon any patriotic grounds whatever, no matter what their pretensions may be. They are in fact doing precisely the same thing as those who resist the introduction or the full use of machinery because they fear that it will reduce the amount of work to be done.

That is a particularly disagreeable story which is being revealed by the rascality of Missouri legislators in connection with the Baking Powder Trust, which seems to have been able by the expenditure of moderate amounts of money to secure the passage of a bill shutting out all competition in the State of Missouri and by the expenditure of additional moderate amounts to prevent the repeal of the bill. It is to be hoped that not only the senators who accepted this money, but those who paid it to them and those who were responsible for paying it to them, will for a time languish in jail. In the meantime it seems curious that people will permit themselves to be swindled in the matter of baking powder when it is a thing which one can so easily make for himself or her-

self. An excellent baking powder is composed simply of cream of tartar and soda. The two mixed together in proper proportions make a baking powder which is at least as good as any that can be purchased and which costs considerably less. No one therefore need be imposed upon by a Baking Powder Trust nor swindled by those who are charged with making a baking powder largely of alum.

A proposition made to the city of Pittsburgh recently, seems to provide a means by which most of the advantages of public ownership of water works, or other public service, can be enjoyed and yet the alleged advantages of a private or corporate management be at the same time secured. A company proposes to lease the water works of the city of Pittsburgh for a period of fifty years and to pay to the city at least $500,000 a year for operating the system. Whether the particular terms offered in this case are fair to the city or not, it is probable that in most cases there is a margin between the most efficient possible private management of a water works and a public or political management of it, which margin will be sufficient to pay a very fair return upon capital employed and to secure and pay for efficient business management. In this way a city, by making a fair bargain with a private company, can retain control of its water supply, can prevent the growth of abuses and at the same time can reap at least a good portion of the advantage to be secured by the most efficient private management.

The National Civic Federation has begun the publication of a Monthly Review, and the first number, which lies before us, contains a symposium by representatives of employers, wage earners, members of the bar and the general public on "Should Unions Incorporate?" Those who are interested in this subject should read this number, especially those who, though they have given the subject little thought, are very positive in their opinion that labor unions ought to be compelled to incorporate, or that they should not be allowed the privilege of doing so. It seems from this showing that employers are by no means unanimous in their desire that unions should be incorporated, and that some of them think it would be a decided disadvantage. Some believe, and give reasons for their belief, that, instead of increasing the responsibility of unions, incorporation would decrease it, and especially that it would decrease the responsibility of individual members.

Arrests have been made in New York city of policemen for extorting money from engineers applying for licenses to take charge of boilers within the city limits. It seems bad enough when people who desire a monopoly of some kind or who are after a public franchise, which the people probably would not grant them, are found to be guilty of bribery, and it has come to a pretty pass if men, who merely seek the opportunity of earning an honest living as engineers or otherwise, must for that privilege pay venial officials $500 to $1,000. It is a shameful condition of affairs and it is to be hoped all concerned in it will be severely punished.

The Manufacturers on the Metric System.

Last week we published an extended abstract from the report of a committee of the National Association of Manufacturers on the metric question and it is curious to observe the different ways in which this report is received by different persons. Those who so strenuously and bitterly oppose anything that looks like an admission that the system may have merits worth looking into, point exultantly to the fact that on most of the direct questions the vote was about 3 to 1 against the metric system, and they claim that this proves that manufacturers do not want the metric system, will have nothing to do with it and that therefore these wicked theorists and impracticable visionaries who are advocating at least a small trial of the system might as well cease from troubling.

But curiously enough there are those who point out that the report is decidedly encouraging for the advocates of the metric system. For instance, a prominent advocate of the metric system, a man of affairs, and an engineer of world-wide reputation, says in speaking of the report, that it shows the rapid growth of feeling in favor of the metric system. He expresses the belief that had the questions propounded by this committee been sent out ten years ago, not half as many favorable replies would have been received. He thinks the foreign business done by our manufacturers, which assumed such large proportions several years ago, did very much to advance the question and expresses confidence that within the next ten years conditions will arise that will bring the matter still more forcibly before them.

Attention is called by another to our summary of the sentiments expressed in letters contained in the report, and which shows that of the eleven who have had no experience with the metric system, six or a substantial majority oppose it, while of the seven who have had experience with it all but one favor it. And so it seems comfort for both sides can be drawn from this report, and both ought therefore to be happy.

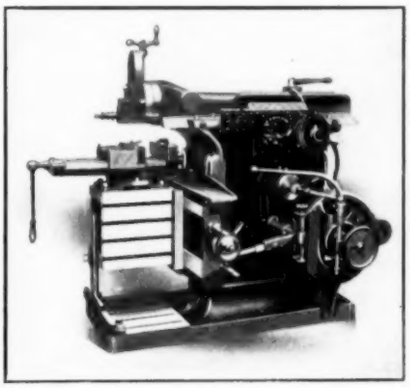
Examination for Draftsman and Engineer.

The United States Civil Service Commission announces that on May 26-27, 1903, an examination will be held for the position of draftsman and engineer. From the eligibles resulting it is expected that certification will be made to two positions of draftsman in the light-house service, in the office of the Engineer of the Third Light House District, Tompkinsville, Staten Island, New York, one at a salary of $100 per month and the other at a salary of $125 per month, and to other similar vacancies as they may occur. Persons who desire to compete should at once apply to the United States Civil Service Commission, Washington, D. C. The exact title as given in this announcement should be used in the application.

Some New Things.

MOTOR-DRIVEN SHAPER.

The half-tone shows a shaper which is built in several sizes, and equipped with either constant or variable speed motor; the motor in this case being of the latter type and giving in connection with the gearing from 5 to 100 strokes of the ram per minute. With a constant speed motor cone pulleys are required for obtaining the variation in speed, these giving, with the



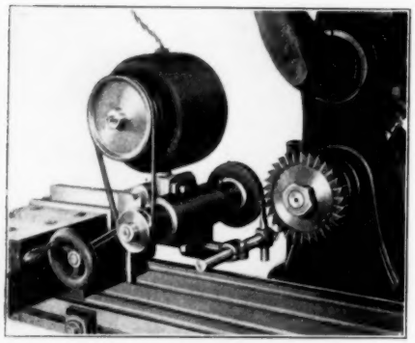
MOTOR-DRIVEN SHAPER.

back gears, eight changes. The means for changing the stroke of the ram, the method of supporting the knee, and the mechanism for feeding the latter are all clearly shown. The rod for actuating the feed, it will be noticed, is carried in a friction socket, and will slip in case of undue strain and so prevent breakage. The pinion on the motor drives a large spur gear, which by means of a friction-clutch is connected to the pinion shaft operating the crank gear; this shaft being connected also with the back gearing inside the column. The back gears are thrown into action by moving the curved handle controlling the friction-clutch (which handle has a brake attachment for stopping the machine immediately), and shifting the short vertical handle to the right. The ram may be shifted by hand by means of the hand-wheel at the end of the driving shaft. The stroke and position of the ram may be changed with the machinery running. Gould & Eberhardt, of Newark, N. J., are the builders.

NEW GRINDING ATTACHMENT.

This attachment may be used in the lathe, shaper, planer or miller, and is adapted for a wide range of work, the illustration showing it as arranged for

grinding a cutter mounted on an arbor in the spindle of a milling machine. The motor is mounted above the wheel spindle and drives the latter through the grooved pulleys and round belt, as shown. The bearings are adjustable for wear and are well protected from grit. The head carrying the spindle and motor swivels in a vertical plane, at the end of the shank (graduations at this point facilitating accurate setting), and has an independent feed of 3 inches by means of worm and hand wheel, the worm meshing with a rack in the head. The worm shaft is shown in the half-tone at an angle with



GRINDING ATTACHMENT.

the spindle, but as now made the rack teeth are cut at an angle and the shaft is parallel with the spindle. A tooth rest or gage, adjustable in all directions, is fitted to the attachment, and an extension spindle is supplied for internal grinding. The motor furnished may be for either alternating or direct current. L. S. Heald & Son, of Barre, Mass., are the makers of this grinding attachment.

Technical Publications.

"The Induction Motor; Its Theory and Design." By H. B. de la Tour. Translated from the French by C. O. Mailloux. 200 6x9-inch pages with 75 illustrations. McGraw Publishing Company, New York. Price $2.50.

This book is offered as a simplified discussion of the complex theory of the induction motor. Such simplification is, however, relative only, as the subject is not capable of absolutely simple treatment. The book is of chief interest to designers of machines of the class of which it treats, for whom it has been written. It is well printed and bound and, considering its class, low in price.

"Trade Marks." Twelve 5x6½-inch pages. Price 25 cents. "The Law of Trade Marks." Thirty-two 5x6½-inch pages. Luther L. Miller, Chicago. Price $1.

These two pamphlets are somewhat similar in contents to the publications which are put out by various patent agencies. The first is intended to show the advantages of trade marks and to give an idea of their use and of what may and may not be registered as a trade mark. The second gives the procedure necessary to protect trade marks in this and other countries, and gives some decisions of the courts showing what does and does not constitute a valid trade mark.

The last of the current series of monthly meetings of the American Society of Mechanical Engineers will be held at the house of the society on the evening of May 5. The topic of the evening will be introduced by a paper on "The Technology of Artistic and Industrial Painting," by Prof. A. H. Sabin. The paper on "Emery Wheels" by Prof Benjamin, previously announced for this meeting, will be presented at the Saratoga meeting.

Preble Machine Works in Chicago, doing marine and contract work, is now conducted by Miss E. F. Jones in consequence of the death of her father, the former proprietor. Miss Jones is a graduate of an engineering school.

The American Institute of Mining Engineers has been compelled to give up its contemplated and partially arranged for trip to British Columbia in July, because suitable cars to make up the special train for the return trip cannot be secured.

Personal.

If "A Reader" will send us his full name and address we will try to help him.

Lucien I. Yeomans has become foreman of the shops of L. S. Heald & Son, of Barre, Mass.

F. B. McCrosky has purchased the interest of Edw. Huber in the business of McCrosky & Huber, of Cincinnati.

By a misprint we were made to say that A. J. Strong had taken a position with the Pattern Tool & Supply Co., of Dayton. For "Pattern," read "Patterson."

Herbert Vanderbeek, formerly with the Electric Vehicle Company, of Hartford, and later with the Westinghouse Electric & Manufacturing Company, of Pittsburgh, has taken a position as engineer of the Studebaker Manufacturing Company, at South Bend, Ind.

Geo. A. Fiske, who has been foreman of the tool department at the New York factory of the Western Electric Company, is now with the New York Bond & Ticket Co., 106 Liberty street. He was presented with a handsome silver loving cup by the employees with whom he has been associated for the past four years.

Obituary.

John Paul McGuire, general superintendent of the Variety Iron Works, Cleveland, Ohio, died at Florence, Col., April 14, forty-seven years old. Mr. McGuire entered the employ of the company in early manhood, and was connected with it continuously thereafter. He was a member of the American Society of Mechanical Engineers.

Commercial Review.

NEW YORK, Monday, April 27, 1903.

Manning, Maxwell & Moore no longer have a sales arrangement on Pond tools, all quotations to them on the products of the Pond Machine Tool Co. having been withdrawn by the Niles-Bement Pond Co.

The situation in the pig iron market at the present time is one of absorbing interest. Although nearly a month has elapsed since the Southern furnaces ordered a reduction in their product for the second half of the year of one dollar per ton, the ultimate effect they will have on prices of iron for that period, is still a matter of uncertainty.

The reduction, as we have already pointed out, was to serve two purposes, viz., to eliminate foreign furnaces as factors in Eastern markets, and to stimulate buying for the last six months of the year. As for shutting out foreign irons, there is still no conclusive evidence that the reductions have accomplished that result. This is because foreign makers seem disposed to pursue a waiting policy, and consumers who have heretofore purchased their material, or contemplated doing so, are following in their footsteps. Consequently foreign irons are attracting little or no attention for the time being.

As for stimulating buying for the second half of the year, the reductions can be put down as a flat failure. There is some talk that producers are not anxious to book orders for that period, but it can be dismissed with a wave of the hand, as any consumer willing to contract at the prices quoted by the furnaces can readily ascertain. The fact is, buyers are at present looking askance at providing for their requirements for the second half, and seem to have concluded that it will pay them to hold off a little while before doing so.

At this writing prices of pig iron are lower than they have been at any time during the past year. What is more, they have displayed a sagging tendency. Buyers who are reluctant to providing for their future supplies, because of the belief that lower prices will eventually prevail, derive the greatest encouragement from the fact. Summing up the situation as it really exists to-day, consumers have the best of the argument, both in the foreign and domestic markets. It is worthy of note, however, that foundrymen are daily in receipt of good orders, and that they view the outlook in an optimistic way. We venture the opinion that not one of them has iron enough on hand or contracted for, to fill one-third of the orders now on their books, which goes to show the confidence they have in lower prices for the remainder of the year.

Among the minor metals substantial declines have recently occurred in tin and copper. In tin the large visible supply which has never been exceeded in the history of the metal, coupled with a slow de-

mand from the country, has brought about a fluctuating market. The situation in copper is a confusing one. Wall Street reports speak of extraordinary consumption, while in immediate trade circles the contrary opinion is expressed. Disinterested observers declare that if the Wall Street diagnosis is correct, buying ought to be on a large scale, and prices ought to be higher. As a matter of fact, immense quantities of the metal, aggregating according to some reports, 5,000,000 pounds, are being offered at concessions in the open market, without any takers.

The adjournment of the New York State Legislature, without passing the bill providing for the erection of a municipal lighting plant in this city, is in conformity with the assurances which have been given in this column from the inception of the movement. The birth of no project was attended with such high hopes of success as this, but at the very time it seemed most possible of fruition, we had the temerity to caution the trade not to take the matter seriously.

We noticed that in the course of the discussion which took place in the Assembly on the bill, one member expressed the opinion that he didn't think it was "on the level." Our advices were to this effect from the very beginning. We live in an age where men assume great undertakings, not so much with the idea of hoping to bring them to a successful conclusion, as for the purpose of meriting public favor, to be used as a political asset later on, or of obtaining some "cheap advertising." There were interests back of this municipal lighting plant matter which wouldn't stand investigation on this score.

The probabilities are we have heard the last of this project for at least a year and a half to come. It may be that when the State Legislature convenes again next January, the bill will be introduced again, but with the membership of the State Senate remaining as it is now until January, 1905 —which body treated the thing as "a joke" when it was brought before it—there is little likelihood of the measure becoming a law in the meantime.

The Northern Engineering Works, crane builders, Detroit, Mich., report recent sales of electric traveling cranes to Lambert Hoisting Engine Company, second order; Ft. Pitt Bridge Works, fourth order; Sessions Foundry Company; Waterbury Machine Company; Union Carbide Company; Webster, Camp & Lane Co., and Hand Cranes to Clarage Foundry Company; Winton Motor Company; Northern Electrical Works; Elk Tanning Company; Windsor Mills; Pawtucket Foundry Company, and a long list of other well known concerns. They report trade conditions better than during the corresponding period last year.

The detailed annual report of the General Electric Company for the year ended January 31, 1903, issued during the week, more than meets the complimentary general allusions we made to it in our last issue. The profits of the company (including a profit of $973,649.74 upon securities sold) after deducting all general and miscellaneous expenses, and allowances for depreciation, losses and writing off $386,875.93 from patent account, and $1,908,324.11 from factory plants and machinery, were..... $10,277,169.16

Less interest on debentures.	44,331.17
	$10,232,837.99
Further deductions from patent account for expenditures incurred chiefly in acquiring the patents of the Sprague Electric Co..	1,613,879.82
	$8,618,958.17
The amount of surplus at the end of last fiscal year was..	15,287,140.65
	$23,906,098.82
Paid in dividends during the year	2,677,263.50
	$21,228,835.32
Stock issued in restoring percentage of reduction made in 1898	16,746,133.33
Surplus January 31, 1903....	$4,482,701.99

The report abounds in many interesting statements, the most notable being that net orders received during the year amounted to $36,685,598, comprising 14,500 customers, against 5,800 of whom there was a debit balance at the close of the year. The orders included generators and rotary converters, capacity over 590,000 kilowatts; railway motors, more than 11,000, capacity over 490,000 horse-power; transformers, capacity over 475,000 kilowatts; stationary motors, more than 16,000; and arc lamps, more than 80,000. The number of factory employees is put down at present at 18,000 hands.

The S. Obermayer Company, manufacturers of foundry facings, supplies and equipments, are making large improvements at their Chicago plant, Eighteenth and Rockwell streets. New machinery and new buildings have just been completed which add about 40 per cent. to their present capacity at the Chicago plant. During the past year improvements were made at the Cincinnati, Ohio, plant, also the Pittsburgh plant, which doubled the capacities at both places. The S. Obermayer Company have now these three plants in full operation, running each plant twenty hours per day, all of them being equipped with the most modern machinery.

Pawling & Harnischfeger, of Milwaukee, Wis., manufacturers of traveling cranes, have leased the shops lately vacated by the Nordberg Manufacturing Company in that city. This was made necessary by reason of the destruction by fire of one of their buildings on April 15 last. The new shops will be in operation around May 1st, and, in connection with their other buildings, will place them in better position to build cranes and hoists than prevailed before the fire. All machinery has already been purchased to equip the shops just acquired.

Three months or so ago, when the Federal Manufacturing Company's sheet steel mill at South Chicago, Ill., was destroyed by fire, there was little expectation that the new mill, then in process of erection at Elyria, O., would be completed in time to be of much service for this season. But by extraordinary effort in pushing the work of building and installation to completion, the new mill is in operation today. The new mill covers five acres of ground, and is a model plant. Although at present this mill is only equipped for rolling cold rolled steel, it is the intention to erect a new building for rolling hot steel. The hot rolling building will be 300x80 feet. All sizes of steel from 2 inches wide up to 16 inches, and in gage from 16 to 3/8 inch is handled. The pickle house dimensions are 50x75 feet. Electric hoists and traveling devices convey the stock from this house to all points in the mill where it is rolled.

The cold rolling department has a capacity of 75 tons a day. This building measures 20x80 feet. Stock up to 16 inches wide and in gage from .010 to .250 is rolled, cut, straightened, slit and sheared. The cold drawing and wire flattening department is located in a building 140x80 feet. The annealing department is 60x80 feet wide, and contains six Swindell furnaces fired by patent gas producers. The shipping room is 60x80 feet. All steel leaves this room in bright condition. The gas producing house, measuring 30x60 feet, is equipped with three machines for supplying gas to the annealing furnaces. The rotary shear in the shearing room takes stock 1/4 inch thick and 26 inches wide in any number of strips.

In all respects this mill is among the most modern in the country. Its equipment has been the special study of David B. Marwick, manager of the plant. Mr. Marwick has had a life-time's experience in steel making and steel working. He held an important position with the Illinois Steel Company before that concern was emerged with other plants in the United States Steel Corporation. Later he was connected with the Morden Frog & Crossing works in Chicago. Then he was superintendent of the Hart & Cooley sheet steel mill at South Chicago, the product of which plant was famed for its adaptability to press work. Mr. Marwick is said to be as familiar with the requirements for steel to be worked up by means of presses as any man in the country.

CHICAGO MACHINERY MARKET.

April is closing with one of the best months, not only of the year, but in the experience of the trade in machinists' supplies. Reports on that score are unanimous. A minority say business is fully up to March, and ahead of April last year. The

majority say trade surpasses both. There is dullness in some of the raw material markets, notably pig iron, because of declining prices, but as denoted by the sale of supplies that go to the factories, consumption of material continues at high water mark. Less is heard concerning the prospective suspension of activities at shops May 1, though the uneventful passage of that date is not at this writing assured for Chicago. In fact in view of the possibility of interrupted operations, some of the shops have ceased to look for business. Nevertheless the work has been coming in steadily unsolicited, so that the outlook is nothing but hopeful. There is possibly one exception to the activity of the supply trade. Builders' hardware and other material going into residence construction have an unfavorable outlook. Makers of builders' hardware are now, some of them, many months behind in their orders so that they cannot feel the unfavorable conditions for some time. But architects are doing little new work. Many of the plans they have drawn are hung up, the prospective builders postponing the erection of houses. The announced reason is that the price of labor has advanced forty per cent. and of lumber and some other material more than forty per cent., as compared with a year or two ago, and that they will wait a while. But there is nothing in the prospects for machine shop work generally that is not encouraging.

C. H. Besly & Co. have moved from Canal street to their spacious and up-to-date new building at 15-21 South Clinton street, where they have more than twice the old floor space. They report an excellent trade, notably for Gardner grinders.

The Chicago office of the Brown & Sharpe Mfg. Co. will be removed soon after May 1 from 23 South Canal street to 16 and 18 South Clinton street, where the company has erected a new and substantially constructed building. They will have in this new structure three times their former space. The building will be equipped with many facilities for transacting business, not possessed in the former quarters. Fred A. Rich, the Chicago manager, reports a splendid trade.

William Ganschow will also remove in May from Canal street to the new shop and office building, which he is now completing at 12 and 14 South Clinton street. He has bought new machinery and will have greatly increased facilities.

The Norton Emery Wheel Company has taken possession of all the floors at 25 South Canal street and is preparing to considerably increase facilities for conducting the rapid growing business of this branch house.

Quotations.

NEW YORK, Monday, April 27.

New York prices for Northern and Southern irons for nearby delivery are as follows:

Northern:	
No. 1 X	$21 50 @ $21 75
No. 2 X	20 25 @ 20 75
No. 2 plain	19 75 @ 20 25
Southern:	
No. 1 Foundry	21 50 @ 21 75
No. 2 Foundry	20 50 @ 20 75
No. 3 Foundry	19 50 @ 19 75
No. 4 Foundry	19 00 @ 19 25

Bar Iron—Base sizes—Refined brands, mill price on dock, 1.95c. upward in carload lots. Smaller quantities from store, 2.15 @ 2.30c.

Tool Steel—Base sizes—Good standard quality, 7c.; extra grades, 10c. and upward.

Machinery Steel — Base sizes — From store, 2.10 @ 2.25c.

Cold Rolled Steel Shafting—2.90c. from store for base sizes.

Copper—Lake Superior ingot 14¾ @ 15c.; electrolytic, 14¾ @ 15c.; casting, 14½ @ 14¾c.

Pig Tin—In 5- and 10-ton lots, f. o. b. New York, 30 @ 30⅛c.

Pig Lead—The American Smelting & Refining Co. on Saturday reduced their quotations 30c. in the hundred to the basis of 4.37½c. in carload lots.

Spelter—5.60 @ 5.75c.

Antimony—Cookson's, 8¼ @ 8½c.; Hallett's, 6¾ @ 7c.; other brands, 6½ @ 6¾c.

Lard Oil—Prime City, 83 @ 85c. according to brand and quantity, ranging from one barrel up to large lots.

Manufacturers.

The Penetentiary Board in Texas is thinking of building a new sugar mill.

The Pittsburgh (Pa.) Brass Foundry Company will build a five-story foundry.

The American Pulley Company, Philadelphia, will erect a new factory building.

Connor Wolf and Emory Burris, Ratcliffburg, O., are going to build a tack factory.

A 50,000 spindle cotton mill is to be erected by the Fulton Bag & Cotton Mills, Atlanta, Ga.

The Monarch Silk Company, York, Pa., is negotiating to establish a plant at Littlestown.

The planing mill machinery and dry kilns of J. F. Wilder, at Epps, Miss., have been burned.

The contract has been let for a new factory for the Eclipse Gas Stove Company, Rockford, Ill.

An addition will be erected to the American Steel & Wire Company's factory, at Worcester, Mass.

The A. Willard Case Company, Manchester, Conn., is contemplating an enlargement of its paper mill.

The Boston (Mass.) & Northern Street Railway Company will build machine and repair shops.

P. J. Moers, Lansing, Mich., will erect a shop manufacturing a new steam and hot water heater.

The Bair & Gazzam Manufacturing Company, Pittsburgh, Pa., has bought a tract for a new foundry.

Plans have been made for a 100x80-foot addition to the plant of the Ajax Metal Company, Philadelphia.

The A. G. Finn Silver Company, Syracuse, N. Y., has purchased a new plant and will enlarge its facilities.

A new machine shop is about to be built by the Pennsylvania Railroad Company at Hollidaysburg, Pa.

Warden Brown is about building an addition to foundry at Thirty-second street and Penn avenue, Pittsburgh.

The plant of the New Castle (Pa.) Forge & Bolt Works is being enlarged by buildings, 300x80 and 300x40 feet.

The United States Headlight Company, Buffalo, N. Y., will build a factory, "L" shape, 400 feet long, two stories high.

The Harbison-Walker Company, manufacturer of fire bricks, Mount Union, Pa., has decided to erect an additional plant.

Contracts have been awarded for a new factory building for the Loew Supply & Manufacturing Company, Cleveland, O.

It is stated at Youngstown, O., that the Central Electric & Manufacturing Company has made plans for a plant in Struthers.

The Biehl Manufacturing Company, of Lancaster, Pa., manufacturer of umbrella handles, etc., will build an addition to a plant.

The Ansonia, Osborn & Cheesman Company, of Ansonia, Conn., manufacturer of braids, webbing, etc., is about to double its capacity.

For the "Georgia road"—said to be identical with the Louisville & Nashville and the Coast Line—shops will be built at Atlanta, Ga.

The Alabama Consolidated Coal & Iron Company may enlarge its plant at Gadsen, Ala., including the erection of a 300-ton furnace.

The Secretary of the Navy has appointed a board to report a plan for the enlargement of the gun factory of the Washington Navy Yard.

Plans have been accepted for a new shop for the University of Maine. The Legislature has made an appropriation of $35,000 for the purpose.

The Standard Disc Plow Company will shortly erect a $30,000 plant in Chattanooga, Tenn., which will give employment to about 300 men.

An enamel ware factory of Dubuque, Ia., will remove to Coshocton, O. A new company is being formed by D. A. Raiff, M. Q. Baker and others.

In the purchase of 33 acres of land at Indiana Harbor, Ind., the Illinois Steel Company has secured a site for its proposed $3,000,000 Portland cement plant.

The Davis Manufacturing Company, Flushing, Mich., may remove to Standish, increasing its capacity. Farm implements, vehicles, furnaces, etc., would be manufactured there.

The Elmore-Fowler-Jacobs Company, recently incorporated, has purchased timber lands and will erect shingle and tie mills. Its general offices are in the Herman Building, Milwaukee, Wis.

Samuel Murchison, it is stated, will endeavor to organize a new company to build a duplicate of the burned mill of the Bellingham Bay Lumber & Shingle Company, of Fairhaven, Wash.

The American Tower & Tank Company is starting to build a factory at Elgin, Ill., to manufacture steel windmills, railroad towers and hydraulic supplies. James Todd, of Batavia, is president.

The A. E. Holliday Manufacturing Company, Fair Haven, Conn., manufacturer of electrical supplies, will build a three-story, 50x100 foot addition and install $8,000 worth of new machinery.

A new cotton mill will be shortly erected either in Charlotte or Columbia, S. C. Will-

iam Coleman, of Waitmires, S. C., will be president and R. L. Tate, of Columbia, treasurer and manager.

The Coates Clipper Company, Worcester, Mass., is rushed with orders and will add to its capacity. The chief addition that is being planned for, however, will not be carried out at present.

The Diamond Match Company has started to invest about $3,000,000 in Butte County, Cal., including the erection of mills and factories at Chico and the construction of a railroad to timber holdings, etc.

The Potter & Johnston Machine Company, Pawtucket, R. I., is just erecting another addition to its plant, which will give it an additional 6,000 feet of floor space. It intends to put in more machinery and tools.

The W. B. Goodenough Lumber Company, organized by W. B. Goodenough, of Marinette, Wis., has purchased 18,000 acres of timber land near Mobile, Ala. A band and planing mill will be erected this summer.

William and Albert Thompson, who recently purchased the plant occupied by the Acme Manufacturing Company, of Southington, Conn., will engage in the drop-forging business and will erect an additional factory.

It is reported at Huntsville, Ala., that additional cotton mills may be built by the Merrimack Manufacturing Company, and also that Hon. T. W. Pratt has practically arranged with some parties to build a new mill at that place.

A 125x58-foot, four-story factory has been designed for W. A. Jones, to be erected at 380 Flournoy street, Chicago; estimated cost, $40,000. It may have something to do with the W. A. Jones Foundry & Machine Company.

Ground has been broken in the Norwood suburb for a $200,000 plant of the L. Schreiber & Sons Company, iron works, Cincinnati, O. There will be a 110x400-foot foundry, a 60x150-foot pattern department and a power plant.

The Mills-Elliott Manufacturing Company, formed by Nelson Mills and others, will soon begin business in Port Huron, Mich. A specialty will be made of the manufacture of dry measures, door springs, refrigerators and gage cocks.

George C. Vaughn, of Salem, Mass., has purchased land in Peabody and it is expected that he will install a plant there to manufacture collar and cuff machines. He has purchased a business which is now conducted at Jamaica Plain.

The Buxton Pump & Iron Works is a company just organized at Nashville, Mich., with an authorized capital of $250,000. A. C. Buxton is president. The buildings are expected to cover five acres, and some 200 men will be employed.

We have an inquiry from Adb-el Rahman Bahig (Manshiet Bahig Boulac St.), Cairo, Egypt, for catalogs of machinery, engines and pumps and for information regarding packing, shipping and customs expenses, terms of payment, etc.

The San Francisco & San Joaquin Coal Company, of San Francisco, Cal., has decided to install machinery for briquetting coal dust, the high price of coal in California rendering this profitable. The briquetting presses will be driven by Westinghouse motors.

The National Automatic Needle Company will build at Springfield, Mass., a factory, 125x40 feet, three stories, with wings, to manufacture primarily a new self-threading sewing machine needle. The machinery to make it was invented by G. A. Manwaring, vice-president and consulting engineer of the company.

A deal has been closed at Clarksburg, W. Va., for property upon which Pittsburgh capitalists will erect a $300,000 brewery this summer. George Eckhert, of Pittsburgh, president of the Union Brewing Company, is at the head of the new concern, which is chartered under the name of the Clarksburg Brewing Company.

The Ball Engine Company, of Erie, Pa., which is building a new plant, is considerably inconvenienced through delay in delivery of a large traveling crane, owing to the fire of Pawling & Harnischfeger, of Milwaukee. The latter concern has leased a plant formerly occupied by the Nordberg Manufacturing Company, for temporary use.

The Victor Stamping Company, Loveland, Ohio, has been recently incorporated and will engage in the manufacturing of tinned, Japanned and galvanized ware, sheet metal stamping, etc. This company intends to equip its plant with the most improved machinery, and makes a general call for catalogs of machine tools, machine shop equipment and supplies.

Eddystone, Pa., has been selected as the site for a railway car manufacturing company. The "Sterling Worth Car Company," of Easton, Pa., has purchased 125 acres of land there, it is said, and is about to erect the plant. The special product is to be a pressed steel freight car. It may be inferred that this has some connection with the Sterlingworth Railway Supply Company, of Easton.

The United States Sulphur Reduction Company, of which Chas. A. Hague, of 114 Liberty street, New York, is treasurer and chief engineer and Harold C. Dayton, secretary and general manager, has started a small plant in Jersey City, N. J., for the production of sulphur from iron pyrites, and intends eventually to establish larger plants. The company's office is at present with the Corporation Trust Company, 135 Broadway, New York.

A charter has been applied for in Delaware for the Penn Engineering & Foundry Company, which proposes to manufacture, lease, sell and operate coin-actuated machines, to operate an iron and brass foundry and machine shop, etc. It is its intention to erect a manufacturing plant in Pittsburgh or vicinity. The incorporators are Harry M. McMillan, F. J. Rutledge and George A. Charles, of Pittsburgh, and others. The capital stock is $250,000.

Cleveland capitalists, whose names are not disclosed, are about to erect at Akron, O., a plant for the manufacture of emery wheels by a patent process, said to be economical. They have purchased the property formerly occupied by the Columbia Insulator Company, in East Akron, and have taken an option on other land, and it is stated that it is their purpose to erect a factory which will employ 500 men at the start. The company is about to be incorporated with $200,000 capital stock under the laws of New Jersey.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Grant. Gears. See upper corner, page 62.

Caliper cat. free. E. G. Smith Columbia, Pa.

Punches & dies. Wal.M.Wks.,Waltham,Mass.

Patterns.—Cincinnati Pat. Wks., Cincin., O.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Wanted—A second-hand shaper and milling machine. F. J. Croninger, Columbus, O.

Working drawings for special machinery. Geo. M. Mayer, M. E., Monadnock, Chicago.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Automatic machinery designed and constructed by the Wellman Sole Cutting Machine Co., Medford, Mass.

Wanted—Competent managers, superintendents and foremen. James Brady, Room J, 20th Floor, 220 Broadway, New York.

Wanted—A set of working drawings of standard Corliss engines of 150 to 200 H.-P. Address, with price, Box 195, AMER. MACH.

Machinists—Send 10 cents for blueprint table of U. S. S. steam, gas and water pipe, giving tapping sizes. E. E. Meyer, Allegheny, Pa.

Wanted—Second-hand gear cutter to cut gears from $\frac{1}{4}$ in. to 4 in. in diameter; state make and condition and whether automatic. Box 208, AMERICAN MACHINIST.

Wanted—Short contributions by practical power plant engineers for a publication for steam engineers; illustrated when possible. Technical Publishing Co., Burns Bldg., Detroit, Mich.

Machinists and Engineers—Simple movement of the slide instantly answers all problems in mathematics; figuring unnecessary; mastered easily; send for free booklet. James Lawlor, Herald Bldg., Fall River, Mass.

Wanted—To purchase, an interest in a small machinery manufacturing plant, by a practical mechanical engineer with broad experience; preferably one in which he can take the position of general manager. Address "Investment," care AMERICAN MACHINIST.

Agency Wanted.—A university educated mechanical engineer with 18 years' experience, in leading position at present, and member of the American Society of Mechanical Engineers, wants to establish himself as a consulting engineer, connecting his office with good agencies. Address "Consulting Engineer," care AMERICAN MACHINIST.

For Sale.

Patent for sale; well-known machinists' tool; taking novelty. W., 344 Walker st., Milwaukee, Wis.

For Sale—One Empire time register, keys, keyboard, etc., in first-class condition; the business has outgrown it. Address Box 201, AMERICAN MACHINIST.

For Sale—50 horse-power Miller improved gas engine; want to sell to make room for 100 horse-power engine; deliver in six weeks. The Ohio Knife Co., 9th st. and McLean ave., Cincinnati, O.

For Sale—Branch of machine tool line, well established 9 years, with domestic and foreign agencies, separate catalogs, etc., in machine tool center of the West; object, specializing. Address "Chance," care AMER. MACHINIST.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. State mentioned indicates present address of advertiser.

Situations Wanted.

CANADA.

Successful superintendent of up-to-date machine shop and foundry, manufacturing large variety of machinery, is open for engagement; in present position 8 years; references. Box 211, AMERICAN MACHINIST.

CONNECTICUT.

Mechanical draftsman wishes to change. Address Box 222, AMERICAN MACHINIST.

Position as foreman or superintendent, by A1 mechanic; 20 years' practical experience; up to date with tools, jigs, fixtures and the production of interchangeable parts. Box 209, AMERICAN MACHINIST.

Mechanical engineer, Stevens graduate, age 38, experienced designer automatic machinery, gas engines, automobiles, tools, dies, fixtures, gages and methods of manufacture for interchangeable work, desires position as superintendent, mechanical engineer or chief draftsman. Address Box 219, AM. MACH.

ILLINOIS.

Mechanical engineers want positions; we have investigated their records and references; we can furnish competent men for all

kinds of technical work. Engineering Agency, 19 Monadnock Block, Chicago.

Want position as manager or superintendent of large machine or boiler shops; held such a place 6 years; 4 years mechanical engineer of large manufacturing concern; now employed; technically educated; up on modern shop methods and accounting; references; will go anywhere. Box 199, AM. M.

NEW JERSEY.

Foundry foreman; R. R. track work, weld joints, molding machines, machinery castings; light and heavy work; references. Box 204, AMERICAN MACHINIST.

NEW YORK.

Machine designer, etc., wants position. Address Box 63, AMERICAN MACHINIST.

Draftsman, 4 years' experience, wants position. Box 221, AMER. MACHINIST.

Technical graduate, experienced, steam pumps, hydraulic machines, desires change. Box 217, AMERICAN MACHINIST.

Mechanical draftsman, technical graduate, experienced, wishes position; electrical work preferred. Box 212, AMERICAN MACHINIST.

Situation as mechanical draftsman, by young man; 3½ years' experience; also had shop practice. 558 E. Main st., Rochester, N. Y.

Machinist, first class, on tools, pattern or fine model making, able to improve, wants paying position out of town. Bruhl, 922 Bedford ave., Brooklyn.

Wanted—Position as foreman with reliable concern; varied experience; can handle help profitably and is a thorough mechanic. Address "O. K.," AMERICAN MACHINIST.

Position as superintendent or general foreman, by an up-to-date man in all branches of the business; is open for engagement. Address C. C., care AMERICAN MACHINIST.

General foreman, responsible man, up-to-date mechanic, experienced in high-class automatic and interchangeable machinery, is open for engagement. Box 194, AMER. MACH.

Experienced mechanical draftsman and designer, 28 years old, technical graduate, desires change; steam and gas engines and pumping machinery. Box 213, AM. MACH.

Mechanical engineer, practical designer, 15 years' experience in shop and drawing-room, general and special machinery, jigs and tools, desires position as chief draftsman or designer; Greater New York. Box 197, AM. M.

Wanted—Position as superintendent or manager, by an up-to-date man; 18 years' experience; understands the business thoroughly from designer to foundry; have handled men up to 1,500; best references. S. F. C., care AMERICAN MACHINIST.

OHIO.

Position wanted by a German draftsman, experienced in all steam boiler systems and overheaters. Write P. Achenbach, Pittroffs Hotel, Main street, Cincinnati, O.

Wanted—Situation as superintendent of machine shop, by a man with practical experience in modern methods and discipline. Address Box 147, AMERICAN MACHINIST.

Position wanted as foreman patternmaker by a man of large experience in making both wood and metal patterns; best of references given. Address "Pattern," care AM. MACH.

PENNSYLVANIA.

Technical graduate desires to change position. Box 191, AMERICAN MACHINIST.

Mechanical draftsman, technical graduate, wants position in automobile factory in Middle West. Box 136, AMER. MACHINIST.

A thoroughly practical man, not given to moving around, wants position as superintendent or general foreman; best references. Address Box 198, AMERICAN MACHINIST.

Foreman patternmaker wishes position; 18 years' experience in marine, mining and Corliss engines; college education. Address "Skeleton," care AMERICAN MACHINIST.

Mechanical engineer, experienced in designing and superintending manufacture locomotives and general machinery, furnaces, structural bridges, etc., is open for permanent engagement; salary $3,000. Address Box 186, AMERICAN MACHINIST.

Mechanical engineer, technical graduate, 12 years' experience as draftsman at steel work, crane design and structural work, desires to become associated with some company or firm who value ability and experience. Box 210, AMERICAN MACHINIST.

As superintendent or assistant superintendent, by a man with technical training and 20 years' shop and drawing-room experience; successful handler of men, and can obtain satisfactory results without cutting wages; systematic record of daily progress; true condition shown without waiting for year end; first-class references. Box 216, AM. MACH.

VERMONT.

Blacksmith with varied experience wishes position as foreman; has had experience as such and can give first-class reference; at present employed, but wishes to change. Box 202, AMERICAN MACHINIST.

Help Wanted.

CANADA.

Brass molders and brass pattern maker for engineers' and plumbing goods. Box 215, AMERICAN MACHINIST.

Wanted—First-class mechanic as speed boss; one who is thoroughly familiar with the capacity and the rate of speed at which all kinds of machine tools should run and the maximum cut they could take; must be thoroughly posted on modern and up-to-date methods. Apply to Canadian General Electric Company, Limited, Peterborough, Canada.

CONNECTICUT.

Wanted—Machinists; first-class men will have steady work and satisfactory pay. U. S. Rapid-Fire Gun & Power Co., Derby, Conn.

ILLINOIS.

Draftsmen for all classes of work; over 200 actual vacancies for technical men in all parts of U. S.; 5,000 positions filled in 10 years. Engineering Agency, 19 Monadnock Block, Chicago.

INDIANA.

Wanted—Two first-class die sinkers on drop forging work; give age, past experience and wages demanded. Box 214, AMER. MACH.

Machine shop foreman wanted; must be thoroughly competent; permanent position; good wages. Address Box 273, Indianapolis, Ind.

IOWA.

Wanted—First-class mechanical draftsman who is familiar with steam shovel and conveyor work. Box 220, AMER. MACHINIST.

MASSACHUSETTS.

Wanted—Machinist for lathe and milling work, also young man for office work, also toolmaker for cutter work. Apply at Boston Gear Works, Boston, Mass.

Machine blacksmith wanted in a job shop near Boston; one who can run a lathe; good pay to a good, handy man; also wanted, milling machine hands. Box 205, AMER. MACH.

Draftsman wanted; leading man on structural steel work and factory buildings; state age, experience, references and salary expected. Address Box 207, AMER. MACHINIST.

Engine designer, of wide experience, capable of developing a line of high-speed steam engines, wanted to take responsible charge of the drafting and designing department of a large and well-known New England firm; a permanent and growing position is open to a man of first-class executive and technical ability. Address Box 181, AMER. MACHINIST.

MICHIGAN.

Wanted—First-class machinists and floor hands on press and die work, also good, all-around blacksmith on die and tool forgings. Address Michigan Machinery Mfg. Co., Ypsilanti, Mich.

NEW JERSEY.

Wanted—Lathe and planer hands for night work on heavy machine tool work; good wages to good men. Apply to The Pond Machine Tool Company, Plainfield, N. J.

NEW YORK.

Lathe hand wanted; state wages. Address "Integrity," care AMERICAN MACHINIST.

Wanted—Machinists for light work; steady employment. W. W. Oliver Mfg. Co., Buffalo, N. Y.

Wanted—A thoroughly competent instrument maker; state experience and pay expected. Address C. D., care AMER. MACHINIST.

Wanted—First-class lathe hands, all-round machinists and toolmakers; steady work; good pay. H. H. Franklin Mfg. Co., Automobile Dept., Syracuse, N. Y.

Wanted—A competent mechanical draftsman and designer for engine and air compressor work; in applying state age, past experience and salary expected. Box 179, A. M.

Toolmaker on screw job, as assistant foreman; must be experienced as to best methods on quality and quantity of products. Garvin Machine Co., Spring and Varick sts., New York.

Machinists wanted for floor or vise work, by a manufacturing concern now employing 275 men; factory located one hour's ride from New York city; wages $2.50 per day of 9 hours; open shop; no labor troubles past or present; none but sober and industrious men wanted; state age, nationality and experience for past 5 years. Box 151, AM. M.

Machinists wanted in a small manufacturing town, one hour's side from New York city; wages $2.50 per day of 9 hours; time and a half for over time; factory employs about 300 men; has been in existence over 20 years, during which time it has never reduced wages or laid off men for lack of work; special inducements will be offered desirable men at this time; state nationality, age and experience for past 5 years. Box 200, AM. M.

OHIO.

Wanted—Lathe hands, planer hands, vise hands, milling machine hands; good wages and steady work. Apply to the Harris Automatic Press Company, Niles, O.

Wanted—Toolmaker familiar with jigs and fixtures for milling machines and Gisholt machines in shop building power transmission machinery. Address, with references, Box T, Cleveland, O.

Wanted—Foreman familiar with stationary engine or steam pump work; only those having had experience as foreman in large works and can furnish good references need apply. Address "Foreman," 135 Clinton st., Cleveland, O.

PENNSYLVANIA.

Lathe men, bench and vise hands wanted. Apply Searchmont Automobile Co., Trainer, Pa.

Experienced mechanical draftsman wanted; permanent employment assured to rapid and accurate draftsman. "Mill Work," care A. M.

Wanted—Several all-around machinists on paper mill machinery; give age and experience. Address Downington Mfg. Co., East Downington, Pa.

Wanted—First-class designers for machine tool and special work; positions permanent; state experience and salary desired. Box 164, AMERICAN MACHINIST.

Machinists—First-class lathe men and engine builder; steady work; permanent situations to right men. Call or address Keystone Driller Co., Beaver Falls, Pa.

Wanted—A first-class mechanical draftsman, familiar with compressor and engine design; state age, salary expected and reference. Box 218, AMERICAN MACHINIST.

Wanted—First-class foreman for machine shop; must have experience in building machine tools and interchangeable work; state experience and salary desired. Box 165, AMERICAN MACHINIST.

Wanted—A first-class man for our assembling department on brass valves, also first-class man as inspector of brass goods, such as valves, lubricators and fittings; state age and experience. Address Box 180, AMER. MACH.

We are constantly increasing the scope of our work, and invite application for positions from first-class patternmakers, molders and machinists; we always have vacancies. Address The Westinghouse Machine Company, East Pittsburgh, Pa.

Wanted—Superintendent for a growing plant manufacturing tools and employing 100 men; factory is new and has modern equipment and ideas; applicant must have mechanical ability, energy, experience and executive ability. Box 193, AMERICAN MACHINIST.

First-class, experienced mechanical draftsmen wanted at once; some of them acquainted with electrical work; those with shop experience preferred. Apply, by letter, to Chief Draftsman, P. O. Box 911, Pittsburg, Pa., stating experience in full and giving references.

Wanted—Experienced foreman to take charge of modern and up-to-date machine shop manufacturing paper-making machinery; must understand modern methods of conducting shop and handling men; state age, experience and where. Address Box 182, AMERICAN MACHINIST.

Wanted—Experienced foreman for about 50 men, in machine department of electric works manufacturing direct-current generators and motors, 2 H.-P. to 800 K. W.; must be capable of producing first-class work at minimum cost. Address, with references and full particulars, Box 206, AMER. MACHINIST.

TENNESSEE.

Wanted—First-class mechanical draftsman, experienced in designing steam pumping machinery; state salary expected. Box 203, AMERICAN MACHINIST.

WEST VIRGINIA.

Wanted—Lathe hand; experienced lathe hand; steady work the year through, in a non-union factory; non-union town. Address "Glass," care AMERICAN MACHINIST.

WEST OF MISSISSIPPI.

Wanted—A genius for making small, particular tools and instruments; good position for the man capable of filling it. Address G. P. Keller, Salt Lake City, Utah.

Bright patternmaker, about 30, for any

class of work, that can do things; must be above the average and not afraid of work; best of pay to one that can meet the requirements. J. L. Gard, Denver, Colo.

Wanted—Inspector and structural and mechanical draftsmen on coal dock construction and equipment; capable, reliable men only wanted; draftsmen to have 2 to 3 years' drawing-room experience; technical graduates preferred. North Western Fuel Co., St. Paul, Minn.

WISCONSIN.

Wanted—Competent machine and bench hands. The Kempsmith Mfg. Co., Milwaukee, Wis.

An experienced crane salesman to represent us on the road; to a man suited to our needs an excellent opportunity is offered; applications treated confidentially. Pawling & Harnischfeger, Milwaukee, Wis.

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Brown & Sharpe Mfg. Co., Providence, R. I.
Davis Mach. Co., W. P., Rochester, N. Y.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.

Cutting-off Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Pratt & Whitney Co., Hartford, Conn.

Cyclometers, Machinery
Veeder Mfg. Co., Hartford, Conn.

Diamond Tools
Steel Set Diamond Co., New York.

Dies, Sheet Metal
Bliss Co., E. W., Brooklyn, N. Y.
Hay-Budden Mfg. Co., Brooklyn, N. Y.
Perkins Mach. Co., So. Boston, Mass.

Dies, Threading, Opening
Errington, F. A., New York.
Geometric Drill Co., New Haven, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Maines Mach. Co., Philadel., Pa.
Modern Tool Co., Erie, Pa.
Pratt & Whitney Co., Hartford, Conn.

Dowel Pins
Obermayer Co., S., Cincinnati, O.
Winkley Co., Hartford, Conn.

Drawing Boards and Tables
Keuffel & Esser Co., New York.

Drawing Instruments
Keuffel & Esser Co., New York.

Drilling Machines, Boiler
Baush Mch. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Bement, Miles & Co., New York.
Dallett & Co., Thos. H., Phila., Pa.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.

Drilling Machines, Bench

Barnes Co., W. F. & John, Rockford, Ill.
Pratt & Whitney Co., Hartford, Conn.

Drilling Machines, Multiple Spindle

Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Barr, H. G., Worcester, Mass.
Baush Mch. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Bickford Drill & Tool Co., Cincinnati, O.
Dallett & Co., Thos. H., Phila., Pa.
Fairbanks Co., New York.
Garvin Mach. Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Newton Machine Tool Works, Philadelphia, Pa.
Niles Tool Works Co., New York.
Prentiss Tool & Supply Co., New York.
Woodward & Rogers Co., Hartford, Conn.

Drilling Machines, Pneumatic

Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneu. Tool Co., Cleveland, Ohio.
Phila. Pneumatic Tool Co., Philadelphia, Pa.
Railway Appliances Co., Chicago, Ill.
Rand Drill Co., New York.
Standard Ry. Equip. Co., St. Louis, Mo.

Drilling Machines, Portable

Dallett & Co., Thos. H., Phila., Pa.
Hisey-Wolf Mch. Co., Cincin., O.

Drilling Machines, Radial

American Tool Wks. Co., Cin., O.
Baush Mch. Tool Co., Springfield, Mass.
Bement, Miles & Co., New York.
Bickford Drill & Tool Co., Cincinnati, Ohio.
Cleveland Punch & Shear Works Co., Cleveland, O.
Dreses Mach. Tool Co., Cincin., O.
Fairbanks Co., New York.
Fosdick Mach. Tool Co., Cincin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Mueller Mach. Tool Co., Cincin., O.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Prentiss Tool & Supply Co., New York.
Reade Mchry. Co., Cleveland, O.

Drilling Machines, Upright

American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Barr, H. G., Worcester, Mass.
Bement, Miles & Co., New York.
Brown & Zortman Mchry. Co., Pittsburg, Pa.
Cincinnati Mach. Tool Co., Cin., O.
Davis Mach. Co., W. P., Rochester, N. Y.
Dwight Slate Mch. Co., Hartford, Conn.
Fairbanks Co., New York.
Fosdick Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Niles Tool Works Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Sibley & Ware, South Bend, Ind.
Washburn Shops, Worcester, Mass.
Whitney Mfg. Co., Hartford, Conn.
Woodward & Rogers Co., Hartford, Conn.

Drilling Machines, Turret

Niles Tool Works Co., New York.
Quint, A. D., Hartford, Conn.
Vanderbeek Tool Works, Hartford, Conn.

Drills, Center

Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Providence, R. I.

Drills, Rail

Bement, Miles & Co., New York.
Niles Tool Works Co., New York.

Drills, Ratchet

Parker Co., Chas., Meriden, Ct.
Pratt & Whitney Co., Hartford, Conn.

Dust Collectors

Allington & Curtis Mfg. Co., Saginaw, Mich.

Dynamos

C & C Electric Co., New York.
Christensen Engineering Co., Milwaukee, Wis.
Commercial Electric Co., Indianapolis, Ind.
Crocker-Wheeler Electric Co., Ampere, N. J.
Eck Dynamo & Motor Co., Belleville, N. J.
General Elec. Co., New York.
Jantz & Leist Elec. Co., Cincin., O.
Mechanical Appliance Co., Milwaukee, Wis.
Milwaukee Elec. Co., Milwaukee, Wis.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Sprague Elec. Co., New York.
Storey Motor & Electric Co., Harrison, N. J.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.

Electrical Supplies

Commercial Electric Co., Indianapolis, Ind.
General Elec. Co., New York.
Milwaukee Elec. Co., Milwaukee, Wis.
Storey Motor & Electric Co., Harrison, N. J.
Triumph Electric Co., Cincin., O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Elevators

Albro-Clem Elevator Co., Philadelphia, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Howard Iron Wks., Buffalo, N. Y.
Morse, Williams & Co., Phila., Pa.

Emery Wheels

See Grinding Wheels.

Emery Wheel Dresser

Calder, Geo. H., Lancaster, Pa.

Enclosures, Tool-room

Merritt & Co., Philadelphia, Pa.

Engines, Automobile

Olds Motor Works, Lansing, Mich.

Engines, Gas and Gasoline

Foos Gas Eng. Co., Springfield, O.
Middletown Mach. Co., Middletown, O.
Mietz, August, New York.
National Engine Co., Rockford, Ill.
New Era Iron Wks., Dayton, O.
Olds Motor Wks., Lansing, Mich.
Regal Gasoline Engine Co., Coldwater, Mich.
Struthers-Wells Co., Warren, Pa.

Engines, Steam

Buffalo Forge Co., Buffalo, N. Y.
Chandler & Taylor Co., Indianapolis, Ind.
Frick Co., Waynesboro, Pa.
Rand Drill Co., New York.
Struthers-Wells Co., Warren, Pa.

Exhaust Fans

Buffalo Forge Co., Buffalo, N. Y.

Fans, Electric

General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Feed Water Heater and Purifier

Hawley Down Draft Furnace Co., Chicago, Ill.

Files and Rasps

Barnett Co., G. & H., Phila., Pa.
Hammacher, Schlemmer & Co., New York.
Nicholson File Co., Provi., R. I.
Patterson, Gottfried & Hunter, Ltd., New York.

Filing Machines

Cochrane-Bly Mach. Co., Rochester, N. Y.

Fillers, Oil Can

The Winkley Co., Hartford, Conn.

Fittings, Steam

Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Jenkins Bros., New York.
Lunkenheimer Co., Cincinnati, O.
Walworth Mfg. Co., Boston, Mass.

Flexible Shafts

Chicago Flexible Shaft Co., Chicago, Ill.

Forges

Buffalo Forge Co., Buffalo, N. Y.
Miner & Peck Mfg. Co., New Haven, Conn.
Patterson, Gottfried & Hunter, Ltd., New York.

Forgings, Drop

Billings & Spencer Co., Hartford, Conn.
Miner & Peck Mfg Co., New Haven, Conn.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic

Wyman & Gordon, Worcester, Mass.

Forgings, Steel

Hay-Budden Mfg. Co., Brooklyn, N. Y.
Wyman & Gordon, Worcester, Mass.

Foundry Furnishings

Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Philadel., Pa.
Smith Fdry. Supply Co., J. D., Cleveland, O.
Whiting Foundry Equip. Co., Harvey, Ill.

Furnaces, Coal and Oil

Buffalo Forge Co., Buffalo, N. Y.
Hawley Down Draft Furnace Co., Chicago, Ill.
Jacobson Mach. Mfg. Co., Warren, Pa.
Obermayer Co., S., Cincinnati, O.

Furnaces, Gas

Am. Gas Furnace Co., N. Y. City.
Chicago Flexible Shaft Co., Chicago, Ill.

Furniture, Machine Shop

New Britain Mach. Co., New Britain, Conn.

Gages, Recording

Bristol Co., Waterbury, Conn.

Gages, Standard

Brown & Sharpe Mfg. Co., Providence, R. I.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gages, Steam

Crosby Steam Gage & Valve Co., Boston, Mass.

Gear Cutting Machinery

Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Dwight Slate Mch. Co., Hartford, Conn.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Newton Mch. Tool Wks., Phil., Pa.
Niles Tool Works Co., New York.
Whiton Machine Co., D. E., New London, Conn.

Gears, Cut

Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Works, Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Fawcus Mach. Co., Pittsburgh, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott Co., The, Cleveland, O.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Philadelphia Gear Works, Philadelphia, Pa.
Sawyer Gear Wks., Cleveland, O.
Simonds Mfg. Co., Pittsburgh, Pa.

Gears, Molded

Caldwell & Son Co., H. W., Chicago, Ill.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cincin., O.

Gears, Rawhide

Chicago Raw Hide Co., Chicago, Ill.
Fawcus Mch. Co., Pittsburgh, Pa.
Horsburgh & Scott, Cleveland, O.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.

Gears, Worm

Albro-Clem Elevator Co., Philadelphia, Pa.
Fawcus Mach. Co., Pittsburgh, Pa.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburgh, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.

Graphite

Dixon Crucible Co., Jos., Jersey City, N. J.
Lubriphite Co., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Center

Heald & Son, L. S., Barre, Mass.
Hisey-Wolf Mach. Co., Cincin., O.

Grinders, Cock

Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter

Adams Co., Dubuque, Iowa.
Automatic Mach. Co., Greenfield, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Machine Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.
Woodward & Rogers Co., Hartford, Conn.

Grinders, Disc

Besly & Co., Chas. H., Chicago, Ill.
Gorton Mach. Co., Geo., Racine, Wis.
Iroquois Mach. Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.

Grinders, Drill

Gorton Mach. Co., Geo., Racine, Wis.
Heald & Son, L. S., Barre, Mass.
Standard Tool Co., Cleveland, O.
Washburn Shops, Worcester, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Tool

Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Barr, H. G., Worcester, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Diamond Mach. Co., Provi., R. I.
Gisholt Mach. Co., Madison, Wis.
Landis Tool Co., Waynesboro, Pa.
Modern Tool Co., Erie, Pa.
Northampton Emery Wheel Co., Leeds, Mass.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, O.
Throop Perforating Co., Buffalo, N. Y.
Whitney Mfg. Co., Hartford, Ct.

Grinding Machines
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Fairbanks Co., New York.
Falkenau-Sinclair Co., Phila., Pa.
Goodell-Pratt Co., Greenfield, Mass.
Gorton Mach. Co., Geo., Racine, Wis.
Greenfield Mach. Co., Greenfield Mass.
Hill, Clarke & Co., Boston, Mass.
Hisey-Wolf Mch. Co., Cincin., O.
Iroquois Mach. Co., New York.
Landis Tool Co., Waynesboro, Pa.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Mechanical Appliance Co., Milwaukee, Wis.
Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.
Norton Grinding Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, Ohio.
Throop Perforating Co., Buffalo, N. Y.
Washburn Shops, Worcester, Mass.
Webster & Perks Tool Co., Springfield, O.
Wilmarth & Morman Co., Grand Rapids, Mich.
Woodward & Rogers Co., Hartford, Conn.

Grinding Wheels
Builders' Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Diamond Mach. Co., Provi., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Whitney Mfg. Co., Hartford, Conn.

Grindstones
Cleveland Stone Co., Cleveland, O.

Gun Barrel Machinery
Bement, Miles & Co., New York.
Diamond Mach. Co., Provi., R. I.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Reed Co., F. E., Worcester, Mass.

Hack Saw Blades and Frames
Diamond Saw & Stamping Wks., Buffalo, N. Y.
Goodell-Pratt Co., Greenfield, Mass.
Hammacher, Schlemmer & Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Starrett Co., L. S., Athol, Mass.
West Haven Mfg. Co., New Haven, Conn.

Hack Saws, Power
Diamond Saw & Stamping Wks., Buffalo, N. Y.
Hoefer Mfg. Co., Freeport, Ill.
West Haven Mfg. Co., New Haven, Conn.

Hammers, Drop
Bement, Miles & Co., New York.
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Merrill Bros., Brooklyn, N. Y.
Miner & Peck Mfg. Co., New Haven, Conn.
Mossberg & Granville Mfg. Co., Providence, R. I.
Perkins Mach. Co., Boston, Mass.

Hammers, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Dallett & Co., Thos. H., Phila., Pa.
Phila. Pneu. Tool Co., Philadelphia, Pa.
Railway Appliances Co., Chicago, Ill.
Rand Drill Co., New York.
Standard Ry. Equip. Co., St. Louis, Mo.

Hammers, Power
Scranton & Co., The, New Haven, Conn.

Hammers, Steam
Bement, Miles & Co., New York.
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Chambersburg Engr. Co., Chambersburg, Pa.
Cleveland Punch & Shear Wks. Co., Cleveland, O.

Heating and Ventilating Apparatus
Buffalo Forge Co., Buffalo, N. Y.

Heating Machines, Automatic
Am. Gas Furnace Co., New York.

Hoisting and Conveying Machinery
Brown Hoisting Mchry. Co., New York.
Caldwell & Son Co., H. W., Chicago, Ill.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

Hoists, Electric
C & C Electric Co., New York.
Hunt Co., C. W., West New Brighton, N. Y.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger, Milwaukee, Wis.
Sprague Electric Co., New York.

Hoists, Hand
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Northern Engineering Wks., Detroit, Mich.
Rand Drill Co., New York.

Igniters, Gas Engine
Dayton Electrical Mfg. Co., Dayton, O.

Indicators, Speed
Starrett Co., L. S., Athol, Mass.

Indicators, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Injectors
Lunkenheimer Co., Cincinnati, O.
Sellers & Co., Wm., Phila., Pa.

Inspection and Tests
Hunt Co., Robt. W., Chicago, Ill.

Instruction Schools
See Schools, Correspondence.

Insurance, Boiler
Hartford Steam Boiler Insp. & Ins. Co., Hartford, Conn.

Jacks, Hydraulic
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Jack Planer
Armstrong Bros. Tool Co., Chicago, Ill.

Key Seaters
Baker Bros., Toledo, O.
Bement, Miles & Co., New York.
Chattanooga Mchry. Co., Chattanooga, Tenn.
Davis Mach. Co., W. P., Rochester, N. Y.
Mutts & Merrill, Saginaw, Mich.
Whitney Mfg. Co., Hartford, Conn.

Keys, Machine
Standard Gauge Steel Co., Beaver Falls, Pa.
Whitney Mfg. Co., Hartford, Ct.

Lamps, Arc
General Electric Co., N. Y. City.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Lathe Attachments
National Machine Tool Co., Cincinnati, O.

Lathe Dogs
Armstrong Bros. Tool Co., Chicago, Ill.
Besly & Co., Chas. H., Chicago, Ill.
Le Count, Wm. G., So. Norwalk, Conn.
Pratt & Whitney Co., Hartford, Conn.
Tindel-Morris Co., Eddystone, Pa.

Lathes
American Tool Wks. Co., Cin., O.
Automatic Mach. Co., Greenfield, Mass.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bement, Miles & Co., New York.
Bradford Mach. Tool Co., Cin., O.
Brown & Zortman Mchry. Co., Pittsburg, Pa.
Bullard Mach. Tool Co., Bridgeport, Conn.
Davis Mach. Co., W. P., Rochester, N. Y.
Diamond Machine Co., Prov., R. I.
Draper Mach. Tool Co., Worcester, Mass.
Fairbanks Co., New York.
Fay & Scott, Dexter, Me.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Greaves, Klusman Co., Cincin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mch. Tool Co., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Milwaukee Machine Tool Co., Milwaukee, Wis.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Pond Mach. Tool Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Reed Co., F. E., Worcester, Mass.
Schumacher & Boye, Cincinnati, Ohio.
Sebastian Lathe Co., Cincin., O.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Washburn Shops, Worcester, Mass.

Lathes, Automatic Screw-Threading
Automatic Machine Co., Bridgeport, Conn.

Lathes, Bench
Faneuil Watch Tool Co., Boston, Mass.
Loop-Lock Mach. Co., Waltham, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Lathes, Boring
Streit Mach. Co., A., Cincin., O.

Letters, Pattern
Brim, A. W., Seneca Falls, N. Y.
Butler, A. G., N. Y. City.

Levels
Mass. Tool Co., Greenfield, Mass.
Starrett Co., L. S., Athol, Mass.

Lockers, Clothes
Merritt & Co., Philadelphia, Pa.
Narragansett Mach. Co., Providence, R. I.

Locomotives, Shop
Hunt Co., C. W., West New Brighton, N. Y.

Lubricants
Besly & Co., Chas. H., Chicago, Ill.
Dixon Crucible Co., Jos., Jersey City, N. J.
Lubriphite Co., Jersey City, N. J.

Lubricators
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lubriphite Co., Jersey City, N. J.
Lunkenheimer Co., Cincinnati, O.

Machine Screws
Atlantic Mach. Screw Co., Boston, Mass.
Worcester Mach. Screw Co., Worcester, Mass.

Machinery Builders, Special
American Fdry. & Mach. Co., Hanover, Pa.
Blanchard Mach. Co., The, Boston, Mass.
Eclipse Mach. Co., Cleveland, O.
Fawcus Mch. Co., Pittsburgh, Pa.
Hart, Fredk., Poughkeepsie, N. Y.
Hoefer Mfg. Co., Freeport, Ill.
Pratt & Whitney Co., Hartford, Conn.
Simonds Mfg. Co., Pittsburgh, Pa.
Wade Mach. Works, Walter H., Boston, Mass.
Woodward & Rogers Co., Hartford, Conn.

Machinists' Small Tools
Besly & Co., Chas. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
McCrosky & Huber, Cincinnati, O.
Mass. Tool Co., Greenfield, Mass.
Patterson, Gottfried & Hunter, Ltd., New York.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Provi., R. I.
Standard Tool Co., Cleveland, O.
Starrett Co., L. S., Athol, Mass.
Wyke & Co., J., E. Boston, Mass.

Machinists' Supplies
Hammacher, Schlemmer & Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.

Mandrels, Expanding
Nicholson & Son, W. H., Wilkesbarre, Pa.

Mandrels, Solid
Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Measuring Machines
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.

Metal, Bearing
Besly & Co., Chas. H., Chicago, Ill.
Patterson, Gottfried & Hunter, Ltd., New York.

Metal, Perforated
Throop Perforating Co., Buffalo, N. Y.

Micrometer Calipers
Brown & Sharpe Mfg. Co., Providence, R. I.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

Milling Attachments
The Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Whitney Mfg. Co., Hartford, Conn.

Milling Machines, Bench
Faneuil Watch Tool Co., Boston, Mass.
Hill, Clarke & Co., Boston, Mass.
Loop-Lock Mach. Co., Waltham, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Horizontal
Adams Co., Dubuque, Iowa.
Beaman & Smith Co., Prov., R. I.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bement, Miles & Co., New York.
Hendey Mach. Co., Torrington, Ct.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Milling Machines, Plain

American Tool Wks. Co., Cin., O.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Fairbanks Co., New York.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Marshall & Huschart Mchry. Co., Chicago, Ill.
McCabe, J. J., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Portable

Underwood & Co., H. B., Philadelphia, Pa.

Milling Machines, Universal

American Tool Wks. Co., Cin., O.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Fairbanks Co., New York.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Marshall & Huschart Mchry. Co., Chicago, Ill.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Vertical

Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bement, Miles & Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Garvin Mach. Co., New York.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mch. Tool Works, Philadelphia, Pa.
Niles Tool Works Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Pratt & Whitney Co., Hartford, Conn.
Quint, A. D., Hartford, Conn.

Milling Tools, Adjustable

Geometric Drill Co., New Haven, Conn.
Rogers, Boat, Gage & Drill Wks., John M., Gloucester City, N. J.

Molding Machines

Adams Co., The, Dubuque, Iowa.
American Foundry & Mach. Co., Hanover, Pa.
Tabor Mfg. Co., Philadelphia, Pa.
Webster & Perks Tool Co., Springfield, O.

Molds, Hammer and Vise Jaw

Field, Chas. H., Providence, R. I.

Motors, Electric

C & C Electric Co., New York.
Christensen Engr. Co., Milwaukee, Wis.
Commercial Electric Co., Indianapolis, Ind.
Crocker-Wheeler Co., Ampere, N.J.
Eck Dynamo & Motor Wks., Belleville, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Mechanical Appliance Co., Milwaukee, Wis.
Milwaukee Elec. Co., Milwaukee, Wis.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Sprague Electric Co., New York.

Motors, Electric—*Continued*

Storey Motor & Electric Co., Harrison, N. J.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.

Name Plates

Franklin Mfg. Co., Syracuse, N. Y.
Turner Brass Works, Chicago, Ill.

Nut Tappers

See Bolt and Nut Machinery.

Oil Cups and Covers

Bay State Stamping Works, Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Bowen Mfg. Co., Auburn, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.
Tucker, W. W. & C. F., Hartford, Conn.
The Winkley Co., Hartford, Conn.

Oils

Besly & Co., Chas. H., Chicago, Ill.
Harris Oil Co., A. W., Provi., R. I.

Oils, Slushing

Harris Oil Co., A. W., Provi., R. I.

Oil Stones

Pike Mfg. Co., Pike Station, N. H.

Packing, Steam Joint

Jenkins Bros., New York.
N. Y. Belting & Packing Co., New York.
Peerless Rubber Mfg. Co., New York.

Pans, Lathe

New Britain Mch. Co., New Britain, Conn.

Pans, Shop

Kilbourne & Jacobs Mfg. Co., Columbus, O.

Patents

Baldwin, Davidson & Wight, Washington, D. C.
Stevens & Co., Milo B., Washington, D. C.

Pattern Shop Machinery

Baker Bros., Toledo, O.
Brown & Zortman Mchry. Co., Pittsburg, Pa.
Fairbanks Co., New York.
Fay & Scott, Dexter, Me.
Greaves, Klusman & Co., Cin., O.
Prentiss Tool & Supply Co., New York.
Washburn Shops, Worcester, Mass.

Patterns, Wood

Hartford Pattern & Model Co., Hartford, Conn.

Pencils

Keuffel & Esser Co., New York.

Pinion Cutters

Loop-Lock Mach. Co., Waltham, Mass.

Pipe and Fittings

Crane Co., Chicago, Ill.

Pipe Cutting and Threading Machines

Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Curtis & Curtis Co., Bridgeport, Conn.
Merrell Mfg. Co., Toledo, O.
Oster Mfg. Co., Cleveland, O.
Reed Mfg. Co., Erie, Pa.
Saunders' Sons, D., Yonkers, N. Y.
Wells Bros. Co., Greenfield, Mass.

Pipe Fitters' Tools

Cleveland Twist Drill Co., Cleveland, O.
Saunders' Sons, D., Yonkers, N. Y.
Standard Tool Co., Cleveland, O.

Planers

American Tool Wks. Co., Cin., O.
Belmer Mach. Tool Co., Cin., O.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del
Cincinnati Planer Co., Cincin., O.
Detrick & Harvey Mch. Co., Baltimore, Md.
Fairbanks Co., New York.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Gray Co., G. A., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.

Planers—*Continued*

Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Niles Tool Works Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Pond Mach. Tool Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Wm., Phila., Pa.
Whitcomb Mfg. Co., Worcester, Mass.
Woodward & Powell Planer Co., Worcester, Mass.

Planers, Bench

Bartlett, E. E., Boston, Mass.

Planers, Portable

Underwood & Co., H. B., Philadelphia, Pa.

Planers, Rotary

Bement, Miles & Co., New York.
Cleveland Punch & Shear Works, Cleveland, O.
Newton Mach. Tool Wks., Philadelphia, Pa.
Pond Mach. Tool Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Presses, Hand

Perkins Mach. Co., So. Boston, Mass.

Presses, Hydraulic

Watson-Stillman Co., New York.

Presses, Power

Automatic Mach. Co., Bridgeport, Conn.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Chambersburg Engr. Co., Chambersburg, Pa.
Fairbanks Co., New York.
Mossberg & Granville Mfg. Co., Providence, R. I.
Perkins Mach. Co., So. Boston, Mass.
Prentiss Tool & Supply Co., New York.

Profilers

Garvin Mach. Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Pulleys

American Pulley Co., Phila., Pa.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Federal Mfg. Co., Cleveland, O.
Howard Iron Wks., Buffalo, N. Y.
Oneida Steel Pulley Co., Oneida, N. Y.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.
The Xylotite Co., Cincinnati, O.

Pulleys, Friction Cone

Evans Friction Cone Co., Boston, Mass.

Pulleys, Speed Changing

Speed Changing Pulley Co., Indianapolis, Ind.

Pulley Turning and Boring Machines

Harrington, Son & Co., Edwin, Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., New York.
Streit Mach. Co., A., Cincin., O.

Pumps, Hydraulic

Watson-Stillman Co., New York.

Punches, Hydraulic

Bement, Miles & Co., New York.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Punches, Power

Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cincinnati Punch & Shear Co., Cincinnati, O.
Cleveland Punch & Shear Wks., Co., Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Perkins Mach. Co., S. Boston, Mass.
Reade Mchry. Co., Cleveland, O.

Rack Cutting Machines

Fellows Gear Shaper Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Reed Co., F. E., Worcester, Mass.

Racks, Cut

Fellows Gear Shaper Co., Springfield, Vt.
Nuttall Co., R. D., Pittsburgh, Pa.
Simonds Mfg. Co., Pittsburgh, Pa.
Standard Gauge Steel Co., Beaver Falls, Pa.

Racks, Tool

New Britain Mach. Co., New Britain, Conn.

Reamers

Cleveland Twist Drill Co., Cleveland, O.
Clough, R. M., Tolland, Conn.
McCrosky & Huber, Cincinnati, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
New Pr ess Twist Drill Co., Taunton, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.

Reaming Stands

Flather Planer Co., Mark, Nashua, N. H.

Rheostats

Cutler-Hammer Mfg. Co., Milwaukee, Wis.

Riveters, Hydraulic

Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Riveters, Pneumatic

Bement, Miles & Co., New York.
Cleveland Pneumatic Tool Co., Cleveland, O.
Philadelphia Pneumatic Tool Co., Philadelphia, Pa.
Railway Appliances Co., Chicago, Ill.
Rand Drill Co., New York.
Standard Ry. Equip. Co., St. Louis, Mo.

Riveting Machines

Bement, Miles & Co., New York.
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Chambersburg Engr. Co., Chambersburg, Pa.
Long & Allstatter Co., Hamilton, Ohio.
Perkins Mach. Co., So. Boston, Mass.

Roller and Ball Bearings

Ball Bearing Co., Philadel., Pa.
Bantam Mfg. Co., Bantam, Conn.
Mossberg & Granville Mfg. Co., Providence, R. I.

Rolling Mill Machinery

Cleveland Punch & Shear Wks., Co., Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Mossberg & Granville Mfg. Co., Providence, R. I.
Pratt & Whitney Co., Hartford, Conn.

Rubber Goods, Mechanical

N. Y. Belting & Packing Co., New York.
Peerless Rubber Mfg. Co., New York.

Rules, Steel

Mass. Tool Co., Greenfield, Mass.
Sawyer Tool Co., Fitchburg, Mass
Slocomb Co., J. T., Provi., R. I.

Safety Valves, Pop

Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O

Sand Blast Apparatus

Paxson Co., J. W., Philadel., Pa

Sand Mixing Machines

Obermayer Co., S., Cincinnati, O
Smith Fdry. Supply Co., J. D., Cleveland, O.

Sawing Machines, Wood

Brown & Zortman Mchry. Co., Pittsburg, Pa.

Sawing Machines, Metal
Cleveland Punch & Shear Works Co., Cleveland, O.
Cochrane-Bly Mach. Works, Rochester, N. Y.
Newton Mach. Tool Works, Philadelphia, Pa.
Pratt & Whitney Co., Hartford, Conn.
Reade Mchry. Co., Cleveland, O.
West Haven Mfg. Co., New Haven, Conn.

Schools, Correspondence
Amer. School of Correspondence, Chicago, Ill.
Consolidated Schools, N. Y. City.
International Correspond. Schools, Scranton, Pa.

Schools, Technical
State College of Ky., Lexington, Ky.

Screw Machines, Automatic
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Dreses Mach. Tool Co., Cincin., O.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Windsor Mach. Co., Windsor, Vt.

Screw Machines, Hand
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Draper Mach. Tool Co., Worcester, Mass.
Garvin Mach. Co., New York.
Jones & Lamson Mch. Co., Springfield, Vt.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Screw Machinery, Wood and Lag
Baker Bros., Toledo, Ohio.
Cook Co., Asa S., Hartford, Conn.

Screw Plates
Besly & Co., Chas. H., Chicago, Ill.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Card Mfg. Co., S. W., Mansfield, Mass.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Oster Mfg. Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Second Hand Machinery
Baird Machy. Co., Pittsburg, Pa.
Bowler & Co., Geo. H., Cleveland, Ohio.
Brown & Zortman Mchry. Co., Pittsburg, Pa.
Carlin Mchry. & Supply Co., Allegheny, Pa.
Fairbanks Co., New York.
Fairbanks Co., Philadelphia, Pa.
Garvin Mch. Co., New York.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mchry. Co., Chicago, Ill.
McCabe, J. J., New York.
Niles-Bement-Pond Co., New York.
Packard Machinery Co., O. L., Chicago, Ill.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Toomey, Frank, Philadelphia, Pa.
Wickes Bros., New York.
Wormer Machy. Co., C. C., Detroit, Mich.

Separators, Oil
American Tool & Mch. Co., Boston, Mass.
National Separator & Mch. Co., Manchester, N. H.

Shapers
American Tool Wks. Co., Cin., O.
Bement, Miles & Co., New York.
Cincinnati Shaper Co., Cincin., O.
Fairbanks Co., New York.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Mach. Co., New York.
Gould & Eberhardt, Newark, N. J.
Hendey Mch. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Kelly Co., R. A., Xenia, Ohio.
Marshall & Huschart Mchry. Co., Chicago, Ill.
New Haven Mfg. Co., New Haven, Conn.

Shapers—*Continued*
Niles Tool Works Co., New York.
Perkins Mach. Co., So. Boston, Mass.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Prentiss Tool & Supply Co., New York.
Steptoe Shaper Co., John, Cincinnati, O.

Shears, Power
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Mach. & Tool Co., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Cincinnati Punch & Shear Co., Cincinnati, O.
Cleveland Punch & Shear Works, Cleveland, O.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Perkins Mach. Co., So. Boston, Mass.
Reade Mchry. Co., Cleveland, O.

Shears, Rotary
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.
Perkins Mach. Co., So. Boston, Mass.

Shelving, Shop
New Britain Mach. Co., New Britain, Conn.

Slide Rests
Bartlett, E. E., Boston, Mass.
Reed Co., F. E., Worcester, Mass.

Slotters
Baker Bros., Toledo, Ohio.
Barr, H. G., Worcester, Mass.
Bement, Miles & Co., New York.
Betts Mach. Co., Wilmington, Del.
Garvin Mach. Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles Tool Works Co., New York.

Sockets and Sleeves
New Process Twist Drill Co., Taunton, Mass.

Sprocket Chains
See Driving Chains.

Stampings, Sheet Steel
Federal Mfg. Co., Cleveland, O.

Stamps, Steel
Schwerdtle Stamp Co., Bridgeport, Conn.

Steel, Machinery
Boker & Co., Hermann, New York.
Patriarche & Bell, New York.
Ward & Son, Edgar T., Boston, Mass.

Steel, Sheet
Federal Mfg. Co., Cleveland, O.
Ward & Son, Edgar T., Boston, Mass.

Steel, Tool
Boker & Co., Hermann, New York.
Firth-Sterling Steel Co., Demmler, Pa.
Patriarche & Bell, New York.
Patterson, Gottfried & Hunter, Ltd., New York.

Stones, Oil
Pike Mfg. Co., Pike Station, N. H.

Straightener, Hydraulic
Bement, Miles & Co., New York.
Watson-Stillman Co., New York.

Swaging Machines
Excelsior Needle Co., Torrington, Conn.
Mossberg & Granville Mfg. Co., Providence, R. I.

Switchboards
C & C Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Tapping Machines and Attachments
Baker Bros., Toledo, O.
The Beaman & Smith Co., Providence, R. I.
Bickford Drill & Tool Co., Cin., O.
Cincinnati Mach. Tool Co., Cincinnati, O.
Errington, F. A., N. Y. City.
Fosdick Mach. Tool Co., Cin., O.

Tapping Machines and Attachments—*Continued*
Garvin Mach. Co., New York.
Geometric Drill Co., New Haven, Conn.
Modern Tool Co., Erie, Pa.
Pratt & Whitney Co., Hartford, Conn.
Quint, A. D., Hartford, Conn.
Webster & Perks Tool Co., Springfield, O.
Whitney Mfg. Co., Hartford, Conn.
Woodward & Rogers Co., Hartford, Conn.

Taps, Collapsing
Geometric Drill Co., New Haven, Conn.

Taps and Dies
Besly & Co., Chas. H., Chicago, Ill.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Crane Co., Chicago, Ill.
Geometric Drill Co., New Haven, Conn.
Hammacher, Schlemmer & Co., New York.
Morse Twist Drill & Mach. Co., New Beuford, Mass.
Oster Mfg. Co., Cleveland, O.
Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.
Webster & Perks Tool Co., Springfield, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Telephone System
Clark Auto. Telephone Switch Board Co., Providence, R. I.

Thread Cutting Tools
Besly & Co., Chas. H., Chicago, Ill.
Oster Mfg. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Tool Holders
Armstrong Bros. Tool Co., Chicago, Ill.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
McCrosky & Huber, Cincinnati, O.

Tools, Small
See Machinists' Small Tools.

Tracing Cloth
Keuffel & Esser Co., New York.
Hardtmuth, L. & C., New York.

Transmission Machinery
American Pulley Co., Phila., Pa.
Caldwell & Son Co., H. W., Chicago, Ill.
Case Mfg. Co., Columbus, O.
Cresson & Co., Geo. V., Phila., Pa.
Federal Mfg. Co., Cleveland, O.
Link-Belt Engineering Co., Philadelphia, Pa.
National Machine Tool Co., Cincinnati, O.
Oneida Steel Pulley Co., Oneida, N. Y.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.

Trimmers, Wood
Washburn Shops, Worcester, Mass.

Trolleys and Tramways
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hunt Co., C. W., West New Brighton, N. Y.
Link Belt Engineering Co., Philadelphia, Pa.
Yale & Towne Mfg. Co., New York.

Tubing, Steel
Shelby Steel Tube Co., Pittsburgh, Pa.

Turret Machines
American Tool & Mch. Co., Boston, Mass.
Automatic Mach. Co., Greenfield, Mass.
Bradford Mach. Tool Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Mach. Tool Co., Bridgeport, Conn.
Dreses Mach. Tool Co., Cincin., O.

Turret Machines—*Continued*
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Gisholt Mch. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Jones & Lamson Mch. Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
Milwaukee Mach. Tool Co., Milwaukee, Wis.
Niles Tool Works Co., New York.
Pearson Mach. Co., Chicago, Ill.
Potter & Johnson Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Turrets, Carriage
Fay & Scott, Dexter, Me.

Twist Drills
Cleveland Twist Drill Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
Morse Twist Drill & M. Co., New Bedford, Mass.
New Process Twist Drill Co., Taunton, Mass.
Patterson, Gottfried & Hunter, Ltd., New York.
Standard Tool Co., Cleveland, O

Universal Joints
Baush Machine Tool Co., Springfield, Mass.
Gray & Prior Mch. Co., Hartford, Conn.
Vanderbeek Tool Wks., Hartford, Conn.

Valves
See Steam Fittings.

Vises, Drill
Graham Mfg. Co., Provi., R. I.
Jacobson Mach. Mfg. Co., Warren, Pa.

Vises, Metal Workers'
Hammacher, Schlemmer & Co., New York.
Hanna, E. E., Chicago, Ill.
Howard Iron Wks., Buffalo, N. Y.
Jacobson Mach. Mfg. Co., Warren, Pa.
Parker Co., Chas., Meriden, Conn.
Reed Mfg. Co., Erie, Pa.
Walworth Mfg. Co., Boston, Mass.

Vises, Pipe
Curtis & Curtis Co., Bridgeport, Conn.
Saunders' Sons, D., Yonkers, N. Y.
Walworth Mfg. Co., Boston, Mass.

Vises, Planer and Shaper
Cincinnati Planer Co., Cincin., O.
Hendey Mach. Co., Torrington, Ct.
Pratt & Whitney Co., Hartford, Conn.

Vises, Wood Workers'
Emmert Mfg. Co., Waynesboro, Pa.
Hammacher, Schlemmer & Co., New York.
Wyman & Gordon, Worcester, Mass.

Welding Machines
Long & Allstatter Co., Hamilton, Ohio.

Wire-Drawing Machinery
Iroquois Mach. Co., New York.
Mossberg & Granville Mfg. Co., Providence, R. I.

Wire-Forming Machinery
Automatic Mach. Co., Bridgeport, Conn.

Wire-Straightening Machinery
Hoefer Mfg. Co., Freeport, Ill.

Worm Hobbing Machines
Pratt & Whitney Co., Hartford, Conn.

Worm Milling Machines
Cleveland Automatic Mach. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.

Wrenches
Coes Wrench Co., Worcester, Mass.

Wrenches, Drop Forged
Billings & Spencer Co., Hartford, Conn.